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第七卷　第四期

目　次

微量元素對水稻苗床之影響
第三報錳對水稻收量之影響(水耕試驗)……………… 徐水泉、邱再發…… 1
水稻經 X 線處理後所發生之突然變異
第一報………………………………………………… 張天定、謝順景…… 7
馬鈴薯種薯供應試驗
第一報應用 2 氯乙烯及硫氰銨催醒馬鈴薯休眠芽之初步研究…… 郭國柱……16
1957 年防治二期作水稻三化螟蟲試驗…………………… 陶家驊……28
螞蟻與鳳梨粉介殼蟲萎凋病關係之研究…………………… 孫守恭……31
施藥時期及次數之不同對棉金鋼鑽蟲防治
效果試驗……………………………………………… 陶家驊、畦國彥……43

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微量元素對水稻苗床之影響

第三報 錳對水稻收量之影響（水耕試驗）

徐 水 泉 邱 再 發

一、前 言

據本試驗第一報[1]及第二報[2]之結果，微量元素之施用對稻苗有良好影響，而可獲得比較健全的稻苗。若如此處理之健全稻苗插秧於本田後之生長及收量能比較未受處理之稻苗良好者，因經費及勞力均輕微而可貢獻於糧食增產實爲利益不少。本試驗以繼續進行水耕栽培探究錳元素對水稻收量之影響。內容可分爲二部分則：(1) 受錳處理的稻苗移植後不施用錳時之生育收量如何？(2) 未受錳處理的稻苗移植後施用錳時之影響如何？

二、試 驗 方 法

第一期作民國43年2月20日播種，同年4月6日移植，同年9月22日收。第二期作民國43年7月30日播種，同年8月15日移植民國44年1月12日收，培養液調製與前報相同插秧後一個月中每星期調換培養液一次，其後改爲兩次。水耕容器使用2公升容量玻璃筒，水稻以石英石固定于小型竹籠而放在玻璃筒口使根部與培養液接觸。雖然玻璃筒放在木箱內，但未能完全遮止光線進入培養液，而水稻根部表面發生綠藻影響其生育，因此第二期作玻璃筒外面塗布油漆。試驗分爲兩部分探討錳之影響，玆將試驗結果報告如下。

三、結 果 及 討 論

（1） 苗床施用錳而移植後無施用錳對水稻收量之影響試驗

育苗時期之錳處理方法與前報相同，移植後之培養液均無施用錳其結果列於表1及表2。

表 1 苗床處理錳之水稻產量（第一期作）

Table 1. The yield of paddy rice treated with Mn in the nursery (1st crop)

區號 Plot No.	苗床處理 Treatment in the unrsery	稈高cm Height of culm	根長cm Length of root	分蘖數 Number of culm	藁產量 Yield of straw (g)			谷產量 Yield of paddy (g)		
					A	B	平均	A	B	平均
0	Mn 0 ppm	84	22	18	35.0	37.5	36.3	10.8	9.4	10.1
1	〃 1 〃	89	23	15	40.0	33.0	36.5	10.0	11.8	10.9
2	〃 2 〃	93	20	15	30.5	37.5	34.0	8.1	11.0	9.5
3	〃 5 〃	92	22	16	34.0	32.0	33.0	11.4	14.2	12.8
4	〃 20 〃	95	21	17	33.5	37.0	35.3	10.8	11.8	11.3
5	〃 50 〃	88	24	15	34.0	42.0	38.0	9.7	9.4	9.5
6	〃 100 〃	89	24	15	41.0	35.0	38.0	11.0	8.7	9.8
7	〃 200 〃	92	24	19	34.0	40.0	37.0	9.0	13.5	11.2
8	〃 500 〃	88	22	17	31.5	39.5	35.0	10.8	8.5	9.6

表 2 苗床處理錳之水稻產量(第二期作)

Table 2. The yield of paddy rice treated with Mn in the nursery (2nd crop)

區號 Plot No	苗床處理 Treatment in the nursery	稈高cm Height of culm	根長cm Length of root	分蘗數 Number of culm	藁產量 Yield of straw (g)			谷產量 Yield of paddy (g)		
					A	B	平均	A	B	平均
0	Mn 0 ppm	106	32	27	47.5	46.5	47.0	10.4	13.0	11.7
1	〃 1 〃	97	31	29	45.5	51.0	48.3	11.5	8.0	9.7
2	〃 2 〃	98	32	27	48.0	51.5	48.7	14.1	12.2	13.1
3	〃 3 〃	100	33	27	36.0	42.0	40.5	13.2	11.4	12.3
4	〃 20 〃	102	31	27	49.5	45.5	47.5	11.0	13.0	12.0
5	〃 50 〃	104	34	20	47.0	39.5	43.2	8.8	13.3	11.0

對其藁及谷收量做變方分析結果，與對照區之差異，第一期作及第二期作均未達顯著標準。

(2) 苗床時未受錳之處理而移植後施用錳對水稻收量之影響試驗

未受錳處理之稻苗，移植後以處理各種濃度之錳進行水耕試驗，其結果列於表 3, 4, 5。表 3 卽第一期作A之稻苗由水耕栽培之稻苗移植，表 4 卽第一期作B之稻苗由本所土壤秧田之稻苗移植。

表 3 移植後處理錳之水稻產量(第一期作A)

Table 3. The yield of paddy rice treated with Mn after transplantation (1st crop A)

區號 Plot No	處理 Treatment	稈高cm Height of culm	根長cm Length of root	分蘗數 Number of culm	藁產量 Yield of Straw (g)				谷產量 Yield of paddy (g)			
					A	B	平均	差異	A	B	平均	差異
0	Mn 0 ppm	84	25	18	35.0	37.5	36.2	0	10.8	9.4	10.1	0
1	〃 0.5 〃	99	24	18	37.0	44.5	40.8	+ 4.6	11.5	9.3	10.4	+ 0.3
2	〃 1 〃	87	22	22	40.0	57.0	48.5	+12.3*	10.4	12.3	11.3	+ 1.2
3	〃 2 〃	90	21	21	53.0	45.5	49.3	+13.1*	12.3	10.0	11.1	+ 1.0
4	〃 5 〃	87	28	21	42.5	51.5	47.0	+10.8*	13.0	10.5	11.8	+ 1.7
5	〃 20 〃	80	25	16	32.5	28.5	30.5	− 5.7	7.5	6.7	7.1	− 3.0*
					L.S.D. 5% = 10.0, 1% = 15.2				L.S.D. 5% = 2.86, 1% = 4.33			

表 4 移植後處理錳之水稻產量(第一期作B)

Table 4. The yield of paddy rice treated with Mn after transplantation (1st crop B)

區號 Plot No	處理 Treatment	稈高cm Height of culm	根長cm Length of root	分蘗數 Number of culm	藁產量 Yield of straw (g)				谷產量 Yield of paddy (g)			
					A	B	平均	差異	A	B	平均	差異
0	Mn 0 ppm	86	22	14	36.0	46.0	41.0	0	11.6	9.2	10.4	0
1	〃 0.5 〃	84	21	18	55.5	47.5	51.5	+10.5	9.8	10.4	10.1	− 0.3
2	〃 1 〃	82	19	17	45.0	43.0	44.5	+ 3.0	11.5	12.0	11.7	+ 1.3
3	〃 2 〃	84	19	18	60.5	50.0	55.3	+14.3	11.5	14.5	13.0	+ 2.6
4	〃 5 〃	87	18	16	44.0	59.0	51.5	+10.5	12.0	12.8	12.4	+ 2.0
5	〃 20 〃	78	19	12	24.0	26.0	25.0	−16.0*	7.0	8.2	7.6	− 2.8
6	〃 50 〃	61	19	7	14.0	16.5	15.3	−25.7**	3.1	3.5	3.3	− 7.1**
					L.S.D. 5% = 14.3, 1% = 21.1				L.S.D. 5% = 3.20, 1% = 4.85			

表 5 移植後處理錳之水稻產量(第二期作)

Table 5. The yield of paddy rice treated with Mn after transplantation (2nd crop)

區號 Plot No	處理 Treatment	稈高cm Height of culm	根長cm Length of root	分蘗數 Number of culm	藁產量 Yield of straw (g)				谷產量 Yield of paddy (g)			
					A	B	平均	差異	A	B	平均	差異
0	Mn 0 ppm	106	32	24	47.5	46.5	47.0	0	10.4	13.0	11.7	0
6	〃 0.5 〃	98	36	28	45.0	52.5	48.7	+ 1.7*	12.2	13.6	12.9	+ 1.2
7	〃 1 〃	105	33	24	64.0	65.5	64.7	+17.7	16.4	14.8	15.6	+ 3.9
8	〃 2 〃	104	35	29	59.0	48.5	53.7	+ 6.7	13.1	12.0	12.5	+ 0.8
9	〃 5 〃	105	33	24	36.0	62.5	49.3	+ 2.3	11.0	14.3	12.7	+ 1.0
10	〃 10 〃	105	36	24	52.5	54.5	53.5	+ 6.5	10.0	10.4	10.2	− 1.5
11	〃 20 〃	106	32	23	33.0	46.5	39.7	− 7.3	7.7	8.0	7.8	− 3.9*
12	〃 50 〃	82	26	14	13.0	13.5	13.3	−33.7**	3.0	2.8	2.9	− 8.8**
					L.S.D. 5% = 16.3, 1% = 22.9				L.S.D. 5% = 3.94, 1% = 5.84			

對第二期作水稻以前報所述之迅速植物體分析法進行化學分析，比色定量水稻中氮、磷、鉀、錳含量。

表 6 水稻中之氮磷鉀錳含量(第二期作)

Table 6. The contents of N, P_2O_5, K_2O and Mn in paddy rice (2nd crop)

區號 Plot No.	處理 Treatment	氮 N (%)		磷 P_2O_5 (%)		鉀 K_2O (%)		錳 Mn (%)	
		藁Straw	根 Rroot	藁 Straw	根 Rroot	藁Straw	根 Root	藁Straw	根 Root
	育苗期施用								
0	Mn 0 ppm	1.74	—	0.81	—	2.76	—	0	—
1	〃 1 〃	1.68	1.87	0.93	0.50	2.81	0.92	0	0
2	〃 2 〃	1.79	1.67	0.65	0.59	3.07	1.27	0	0
3	〃 5 〃	1.89	1.84	0.67	0.49	3.02	0.97	0	0
4	〃 20 〃	1.78	1.84	0.92	0.39	3.53	1.13	0	0
5	〃 50 〃	1.77	1.62	0.88	0.35	2.70	1.45	0	0
	移植後施用								
6	Mn 0.5 ppm	1.64	1.59	0.90	0.28	2.01	1.15	0	0
7	〃 1 〃	1.67	1.56	1.23	0.56	2.84	1.34	0.08	0
8	〃 2 〃	1.69	1.65	0.94	0.24	3.15	1.36	0.10	0
6	〃 5 〃	1.70	1.62	0.83	0.38	2.45	1.33	0.10	0
10	〃 10 〃	1.60	1.47	0.77	0.39	2.64	1.19	0.20	0.08
11	〃 20 〃	1.69	1.79	1.08	0.42	2.79	0.92	0.30	0.08
12	〃 50 〃	1.85	1.91	1.18	0.66	2.58	0.88	0.34	0.19

苗床時期施用錳對稻苗雖然有效果，但稻苗移植後無繼續施用者，其效果即消失。又育苗時期錳施用濃度達至 20ppm 以上者，有顯著的毒害現象，但移植後暫暫回復正常生育而至收穫時已與對照無錳區生育情形大略相同。如表 1,2 之收量結果，雖然有少許差異，但並不是育苗時期所施用錳之影響所致。據變方分析結果，其差異均不顯著。總而言之苗床時期施用錳對其後生育及收量均無多大影響。

移植後施用錳對水稻生育，如表 3,4,5 有明顯的影響。尤其適量之施用對分蘗及藁谷收量均有良好影響。對各期作之產量算其平均，結果如下。錳濃度 Mn1～5ppm 效果最佳，20ppm 時減少收

量，而 50ppm 時錳毒害甚大。

處理 Treatment (Mnppm)	0	0.5	1	2	5	10	20	50
藁產量 Yield of straw (g)	41.4	47.0	52.5	52.7	49.2	53.5	31.4	14.3
指　數 Index	100	114	128	128	119	129	76	34
谷產量 Yield of paddy (g)	10.7	11.1	12.8	12.2	12.3	10.2	7.5	2.1
指　數 Index	100	103	119	114	114	95	70	19

爲明瞭育苗時期及移植後施用錳對收穫水稻之氮、磷、鉀、錳含量有無影響，而進行化學分析結果，除移植後施用錳之水稻，其錳含量與施用量有正相關之外，氮、磷、鉀含量並無明顯的增減之傾向。此等要素含量在藁部比根部高。

四、摘　　　要

爲明瞭錳對水稻收量之影響進行水耕試驗。育苗時期使用 500ml燒杯，移植後使用 2 l 玻璃筒爲水耕容器，每星期調換培養液二次。本試驗分爲兩部分。

（1） 苗床施用錳對水稻收量之影響：錳處理之稻苗移植後不施用錳，其結果錳處理與對照無錳區之生育情形及收量大略相同。因此受錳影響之健全稻苗其後之生育中無繼續施用者其效果卽消失。

（2） 移植後施用錳對水稻收量之影響：依錳濃度不同影響水稻生育甚大。尤其適量之施用對分蘖及藁谷收量有良好影響。Mn 1～5 ppm 時效果最佳，20ppm 時收量減少，50ppm 時毒害甚大。對照區（無錳）之藁收量爲 100 時，Mn 1～5 ppm 爲 124，Mn 20 ppm 爲 76，Mn 50 ppm 爲34。對谷收量之指數，Mn 1～5 ppm 爲 116，Mn 20 ppm 爲 70，Mn 50 ppm 爲 19。

培養液錳濃度對水稻中錳含量有正相關而對水稻中氮、磷、鉀含量似乎無影響。此等要素含量在藁部比根部高。

參　考　文　獻

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EFFECTS OF SOME MINOR ELEMENTS ON THE NURSERY BED OF RICE PLANTS

(III) THE EFFECT OF MANGANESE ON THE YIELD OF PADDY RICE (WATER CULTURE EXPERIMENT)

by

S. C. Hsu and T. F. Chiu

SUMMARY

In order to ascrtaining the effect of manganese on the yield of paddy rice, water culture experiment were carried out in the green house. 500 ml. beakers as germination beds and 2 litre glass cylinders as water culture vessels were used. Culture solution was changed twice a week. There were two sections in this experiment being concerned.

(1) The effect of manganese applied in the nursery on the yield of paddy rice; Manganese was only applied in the nursery but not after transplantation. The result showed little difference of the growth of rice plants between the check plot and the treated plot after transplantation. It indicated that manganese absorbed by rice seedlings did not influence the latter growth of rice unless manganese would be applied continuously after transplantation.

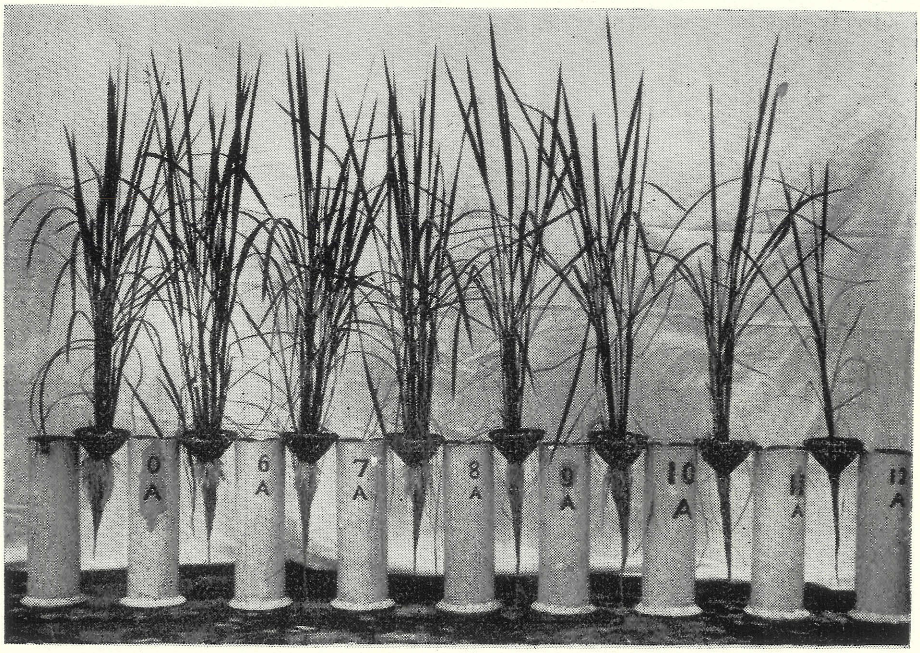
(2) The effect of manganese applied after transplantation on the yield of paddy rice; Manganese effect much on the grwoth of rice plant due to the concentratration of Mn in culture solution. Number of culm, yields of straw and grain in the optimum Mn plot was increased, and the difference between the treated plot and the check plot was significant. Taking the yields of straw and grain of the check plot as 100 respectively, that of the other treated plot was calculated as follow; (Mn 1–5 p.p.m.) 124, (Mn 20 p.p.m.) 76, (Mn 50 p.p.m.) 34 for indices of straw, and (Mn 1–5 p.p.m.) 116, (Mn 20 p.p.m.) 70, (Mn 50 p.p.m.) 19 for the indices of grain.

High correlation between Mn content in rice plant and Mn concentration in culture solution was obtained by chemical analysis. N, P_2O_5, K_2O contents in rice plant were not influenced by Mn treatment. The contents of these elements in straw was higher than that in root.

移植後施用錳之影響

第一期作（參照表 4）

第二期作（參照表 5）



區　號 No.	第一期	0	1	2	3	4	5	6	第二期	0	6	7	8	9	10	11	12
處理 Mn ppm		0	0.5	1	2	5	20	50		0	0.5	1	2	5	10	20	50

MUTATIONS IN RICE INDUCED BY X-RAYS

(A PRELIMINARY REPORT)

by

TIEN-DING CHANG and SUNG-CHING HSIEH

The early studies of X-ray treatment in rice were mostly aimed to induce genic changes, while structural changes of the chromosomes were rarely reported, though Ramiah and Parthasarathy (1935) found chromosome ring in X-rayed rice.

Since Yamashita (1949) advocated that reciprocal translocations induced by X-rays were usable for linkage analysis, Nishimura (1950), Oka (1953) and Chang (1955) began to study this problem and some reciprocal translocation stocks were obtained.

For the purpose of isolating reciprocal translocation lines for linkage group analysis, writers initiated an experiment to treat rice with X-rays in 1947 and again in 1954 and have obtained mutants such as semi-sterile rice, dwarf plants, chlorophyll deficiencies and others. The general characteristics and inheritance of these mutants, and the effect of different dosages of X-rays on the quantitative characters will be reported in this paper.

Materials and the conditions of X-ray treatments are shown in table 1.

Table 1. Conditions of X-ray treatment

	1st treatment	2nd treatment
Variety	Taichung no. 65, Pei-ko-fa-lo	do
Date	Feb. 14, 1948	Feb. 17, 1954
Place	Plant Breed. lab. of Taiwan University	Taiwan University Hospital
Seeds	Germinating seeds	do
Current	4 m.a.	5 m.a.
Voltage	80 k.v.	100 k.v.
Filter	no	¼Aluminum filter (Beryllium window) open (no cone)
Distance	30 cm.	
Duration of treatment	50, 60, 70, 80, 90, 100, 120 min.	19 min. 15 sec., 26 min. 56 sec., 30 min. 5 sec., 34 min. 27 sec.
Dosage		5,000r, 7,000r, 8,000r, 10,000r.
Temperature	Indoor temp.	do

Growth conditions, percentage of the lethal seedlings, plant height and number of tillers were observed in the 1st generation (X1). Panicles of X1 generation were harvested individually as the different X2 lines. Special care was paid to the different kinds of mutants.

1. Effect of different dosages of X-rays upon the frequencies of lethal seedlings, mutants and quantitative characters

The percentage of lethal seedlings in X1 generation was ranged from 22 to 100% and increased as the duration of X-ray treatment was prolonged. This is shown in table 2. The seedling growth of treated plants was slower than that of untreated ones.

Table 2. Percentage of lethal seedlings in X1 generation

Variety \ Duration of X-ray treatment (min.) / Percentage of lethal seedlings	80	90	100	110	120	Control
Taichung no. 65	22	92	92	84	98	0
Pei-ko-fa-lo	60	90	92	86	100	0

In some cases, seedlings with twisted leaves were observed but recovered to normal condition before long. As mentioned above, dwarf, semi-sterile, variegated, albino and other mutants were found in X1 generation. Their frequencies are given in table 3.

Table 3. Frequency of occurrence of mutants in X1 generation

	No. of fertile plant	No. of semi-sterile plant	No. of dwarf plant	No. of other plant	Total no. of plant observed
No. of plant observed	854	134	2	18	1,008
Percentage of mutant	85.2	13.2	0.2	1.4	100

Different degrees of chlorophyll deficiencies were found in X1 generation of Taichung no. 65 in lst treatment. These abnormal chlorophyll deficiencies were classified into three classes; namely, cream, variegated and albino plants. The cream plants showed light yellowish white coloration and without chlorophyll content. Albino plants were colorless, being wholly lack chlorophyll and died when the plant heights reached 5–10 cm. Variegated plants showed to have 1 to 3 colorless strips along the vein of leaves and also in leaf sheathes. Such variegated seedlings were viable except a few ones which dies at the early growing stage. Sometimes twisted leaves were found among the variegated plants. In some cases, the white strips turned green at the late growing stage. These chlorophyll deficiencies induced by X-rays might be due to the plastid mutations as explained by Imai (1935).

The rate of occurrence of chlorophyll deficiencies in the seedlings of X1 generation of X-rayed rice is given in table 4. The table shows that there were no clearcut relations between the rate of chlorophyll deficiency occurrence and the duration of

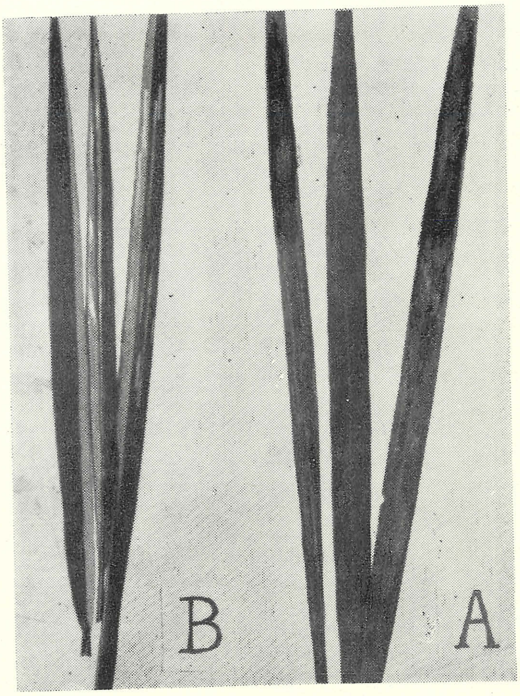


Fig. 1. Chlorophyll deficiency in X-rayed rice
A. Normal leaf
B. Variegated leaf

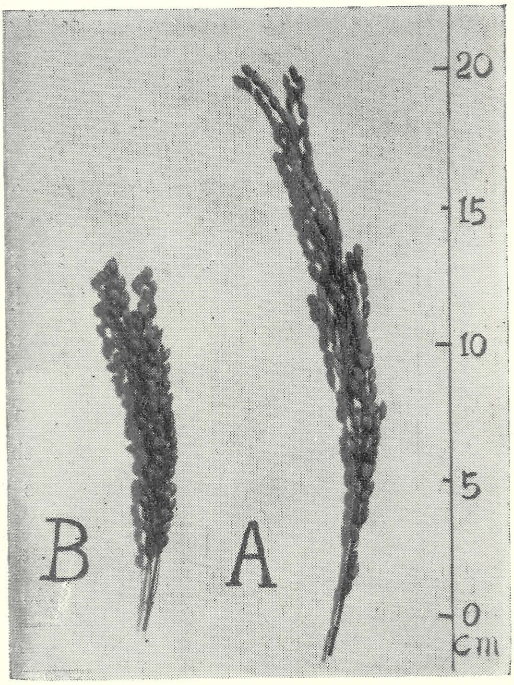


Fig. 2. Panicles of rice
A. Normal panicle of Taichung no. 65.
B. Panicle of dwarf rice induced by X-rays

Table 4. Rate of occurrence of chlorophyll deficiencies of X-rayed strains in X1 generation

Duration of X-ray treatment \ No. of seedlings and percentage \ leaf color	Green	Cream	Variegated	Albino	Total no. of plant
50 min.	1492 (85.1)	87 (4.9)	48 (8.4)	27 (1.6)	1654 (100)
60	503 (87.9)	5 (0.9)	58 (10.1)	6 (1.1)	572 (100)
70	110 (91.6)	0	10 (8.4)	0	120 (100)
80	251 (86.8)	26 (8.9)	9 (3.1)	3 (1.2)	289 (100)
90	108 (99.1)	0	1 (0.9)	0	109 (100)
Total	2464 (89.8)	118 (4.1)	126 (4.6)	36 (1.5)	2744 (100)
Control	458 (98.3)	0	8 (1.7)	0	466 (100)

X-ray treatments. Therefore, this plastid mutations seemed to be relatively easy to occur regardless of dosages of X-ray applied.

Seedling heights (measured on March 22, i.e. 35 days after sowing), plant heights (measured on July 7, i.e. 110 days after sowing), and the number of tillers were observed in the field while the length and weight of panicles were calculated in the laboratory after the harvest. These results are given in table 5. It will be seen in table 5, that the seedling heights were supressed differently by different dosages of X-rays. There was a tendency that, the degree of X-ray supression to seedlings was increased by the increase of X-ray dosages. The rate of seedling growth was varied differently according to the dosages of X-rays. The range of variation was wide in 10,000r treatment, being less in 7,000r treatment. The table also indicates that the effects of different dosages of X-rays on the plant heights, number of tillers, number of panicles, length and weight of panicles were not very distinct.

Table 5. Effect of different dosages of X-rays on the quantitative characters in rice

Treatments	Average of each character						
	Seedling height (cm)	Plant height (cm)	No. of tillers	No. of panicles	Length of panicles (cm)	weight of panicles (gr)	Total no. of plant calculated
Taicung no. 65							
7,000r	16.2	113.5	11.9	8.6	23.2	3.8	180
8,000r	14.4	113.3	10.6	8.6	23.2	3.9	200
10,000r	14.6	112.4	10.5	7.8	23.7	3.2	60
Control	16.8	114.3	11.7	8.4	23.7	3.5	50
Pei-ko-fa-lo							
7,000r	14.0	137.0	10.8	7.9	23.4	3.5	130
8,000r	17.8	133.0	9.2	7.4	23.3	3.4	170
10,000r	17.7	140.0	10.2	7.6	23.7	3.6	60
Control	18.2	140.0	10.5	7.6	23.7	3.6	50

2. Variation of fertility and its inheritance

As mentiond above, there occurred semi-sterile plants in X1 generation. The rate of occurrence of semi-sterile plants was different according to different dosage of X-ray treatments. The fertility was different in different plants and even different in the different panicles within a plant (table 6). It will be seen in table 6 and fig. 3, that the fertility was reduced when seeds were treated with strong dosage of X-rays. If aiming to obtain semi-sterile rice plants, at least 5,000r of X-ray is necessary for germinating seeds and more than 10,000r will get better results.

Table 6. Effect of different dosages of X-rays on the fertility in X1 generation

Treatments \ Freq. of single panicle in % \ Fertility in %	10	20	30	40	50	60	70	80	90	100	Total (%)	Total no. of panicles calculated
Taichung no. 65												
5,000r	3.9	4.2	5.1	7.0	8.3	8.7	11.7	13.7	20.4	17.0	100	2,162
7,000r	9.1	4.6	5.8	4.9	7.9	7.6	8.6	10.2	18.6	22.5	100	1,586
10,000r	8.3	5.8	8.3	2.0	9.9	8.8	9.7	7.2	10.2	19.9	100	433
Control	0	0	0	0	1.4	2.6	5.4	25.2	32.4	32.8	100	425
Pei-ko-fa-lo												
7,000r	12.8	10.1	10.5	9.7	9.5	8.8	12.5	9.9	9.8	6.5	100	891
8,000r	12.1	9.2	8.3	9.8	8.6	9.7	10.1	11.8	12.7	7.6	100	1,402
10,000r	16.5	9.7	7.8	10.7	9.6	7.7	9.4	10.1	12.3	6.1	100	934
Control	3.7	3.0	7.4	11.1	6.7	8.1	15.5	12.6	16.3	15.6	100	135

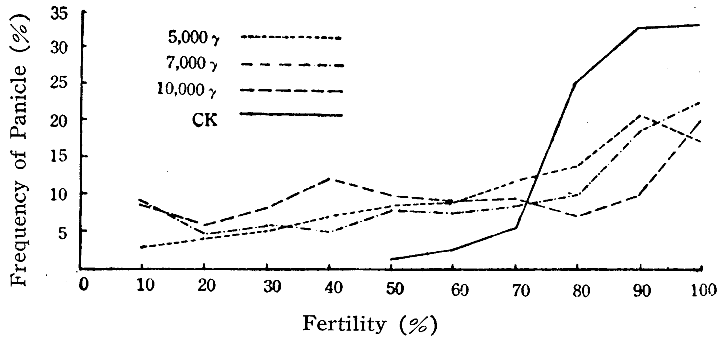


Fig. 3. Effect of different dosages of X-rays on the fertility in X1 generation (Taichung no. 65)

As mentioned above, the different panicles of semi-sterile plants of X1 generation were harvested seperately, and their fertility seemed to show both continuous and discontinuous variations. Some lines of those showing discontinuous variation in fertility, segregated the fertile and semi-sterile plants in approximately 1 to 1 ratio in the X2 generation. In the X3 and later generations the fertile plants were found to breed true, but the semi-sterile plants continues to segregate in the same manner as in the X2 generation (table 7). Such a behavior of sterility to be of the same type as reported by Oka (1953), Chang (1955) and others [6,8]. Based on the result of cytological observation, 10 to 90% of ring, chain and other types of quardrivalent chromosomes (Unpublished) found in the semi-sterile plants of the said lines by ordinary aceto-carmine smear method, the semi-sterility was proved to be attributed to the segmental interchange.

Table 7. Segregation of fertile and semi-sterile plants in semi-sterile rice

Strains	Fertility in Semi-sterile plant(%)	Fertility of self-pollinated plants (%)										Total no. of plant
		10	20	30	40	50	60	70	80	90	100	
B S1-3-1	35.3				10	4		2	5	8	1	30
					(14)				(16)			
B S2-3-1	33.9	1		2	7	5	1		1	14	4	35
				(16)						(19)		
B S3-3-1	28.8		1	2	7	2	5	5	2			24
					(17)			(7)				
B S5-1-1	23.0			1	8	4		2	5	7		27
					(13)				(14)			
B S6-3-4	33.0	1			8	5		3	2	6	1	26
				(14)					(12)			
B S10-2-7	33.8			2	6	4		4	4	3	2	25
					(12)				(13)			
B S11-1-20	33.8				2	2			2	2	1	9
					(4)					(5)		
B S12-1-1	21.8			4		1				2	3	10
					(5)					(5)		
B S13-2-1	26.5			2	6		1	1	3	4	3	20
					(9)				(11)			
B S14-1-1	29.5			7	6	1			3	8	1	26
					(14)					(12)		
B S16-1-1	29.4			1	4	8	2		1	5	6	27
					(15)					(12)		
B S17-3-2	27.3			6	7				1	7	6	27
				(13)						(14)		
B S18-2-18	24.0			1	7	8			3	7	2	28
					(16)					(12)		
B S19-2-2	26.0			4		3	6	6	3	6		28
						(13)			(15)			

3. Occurrence of dwarf plant and its inheritance

As indicated before, two dwarf plants were obtained from 80-minute treatment of Taichung no. 65. Panicles of these plants were short, grains were small in size but fertility was normal. No segregation was taken place in the subsequent generations after selfing, and all characters shown to breed true. Table 8 shows differences of general characterisics between Taichung no. 65 and dwarf rice.

Table 8. Comparison of general characteristics between Taichung no. 65 and dwarf rice

Items	Original Taichung no. 65	Induced dwarf mutant
Plant height (cm)	100.3	75.5
No. of tillers	8.5	6.7
Length of boot leaf (cm)	36.5	27.8
Width of boot leaf (cm)	1.4	1.8
Length of panicle (cm)	20.6	15.5
Weight of panicle (g)	3.4	2.8
Average density of panicle	7.2	11.2
Weight of 1,000 grains (g)	27.9	20.9
Length of hulled rice (mm)	5.2	4.2
Width of hulled rice (mm)	3.1	2.8
Thickness of hulled rice (mm)	2.1	2.0
Percentage of fertile grain	92.3	83.3

In order to know genetic behavior of dwarf rice, it was crossed to original variety Taichung no. 65. Fl plants were normal but normal and dwarf plants were segregated into 3 to 1 ratio in the F2 generation (table 9). This shows that dwarfism is controlled by single gene and that the dwarf gene is recessive. This indicates that dwarf rice might be resulted from genic change as it could be expressed as A→a. Whether there were small chromosome deficiencies which were hard to recognize under microscope, was a problem of further studies.

Table 9. Segregation ratio of F2 in the "hybrid between Taichung no. 65 and dwarf rice

	Normal plant	Dwarf plant	Total
Expected (3:1)	56.25	18.75	75
Observed	54	21	75

$X^2=0.36$ d.f.=1 $0.5<P<0.7$

It is concluded, according to the observation, that those semi-sterile lines, which segregated fertile and semi-sterile plants in approximately 1 to 1 ratio and showed the occurrence of ring chromosomes, might be reciprocal translocation heterozygotes. If plants of these semi-sterile strains were crossed to the original Taichung no. 65, both fertile and semi-sterile plants should be expected as the same manner as the selfing of semi-sterile plants. If the original variety were crossed to fertile plants, either fertile or sterile plants could be produced. Whether these lines fitted this genetical behavior, further cytological observations and test cross are necessary for comfirmation. As reciprocal translocation lines are useful materials for linkage analysis and for other genetic studies, the writers are now on the way to isolate more strains of this kind.

ARKNOWLEDGEMENT

The present work was carried out in the genetic laboratory of Taiwan Agricultural Research Institute. The writers wish to express their hearty thanks to Dr. H. I. Oka of National Institute of Genetics of Japan for his kind guidence and revision. They also deeply indepted to Dr. C. Y. Chao of National Taiwan University for his kind revision and many suggestions.

RÉSUMÉ

The aims of these experiments are to obtain mutations by X-ray irradiation and to take advantages of the treatment thus induced for linkage analysis. Germinating seeds of two varieties, Taichung no. 65 (a representative of Ponlai variety or Japanica type in Taiwan) and Pei-ko-fa-lo (a native variety of lst crop nature) were used. Dose

of X-rays: lst treatment; 4 m.a. 80 k.v. 30 cm, 50–120 minutes. 2nd treatment; 5 m.a. 100 k.v., 19–35 mimutes, 5,000r, 7,000r, 8,000r and 10,000r. The percentage of lethal seedlings of the X1 generation was ranged from 22 to 100% being related the dulation of irradiation. The fertility of X1 generation tended to decrease markedly with the duration of irradiation.

The frequency of chlorophyll deficiencies was quite high in the treated Taichung no. 65. in the X1 generation. The effect of different dosages of X-ray treatment on various quantitative characters was not very distinct.

Dwarf rice as tall as 3/4 of the original variety was obtained among the X2 generation of Taichung no. 65 from 80-minute treatment. It was crossed to original variety. The F2 generation fitted 3 to 1 segregation ratio. Part of the segregating progenies of semi-sterile rice showed continuous variation, and the mechanism involed is rather complex and remained to be elucidated. Part of semi-sterile strains showed discontinuous variation in fertility, which segregated fertile and semi-sterile plants in approximately 1 to 1 ratio and showed the occurrence of ring chromosomes considered to be attributed to the segmental interchange.

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水稻經 X 線處理後所發生之突然變異

（第　一　報）

張　天　定　　謝　順　景

摘　　要

爲誘發染色體構造的變化，以獲得多數不同之相互轉座系統，進一步作稻之連鎖分析爲目的，乃舉行本試驗。試驗材料爲臺中 65 號（蓬萊種）及白殼花螺（在來種）之發芽種子。X線處理分爲兩次：第一次之處理條件；電壓 80 kv，管電流 4 ma. 距離 30 cm 時間 80–120 分，第二次處理條件；電壓 100 kv，管電流 5 ma. 時間10–35 分，放射線量爲5,000r, 7,000r, 8,000r, 10,000r 等四種。

處理當代幼苗之致死率爲 22–100%，隨X線量照射時間而增，處理當代（80 分處理區）不稔個體之發生頻度爲 13.2% 矮稻之發生率爲 0.2%。

在處理第一代臺中65號之幼苗發現淡黃色苗(Cream)，條紋苗(Variageted)，及白苗 (Albino) 等葉綠素缺乏之系統。淡黃色苗及白苗生長後不久卽告死亡，但條紋苗可繼續生長，此種變異體可能爲色素體之變異 (Plastid mutation) 所致，不同X線量對於第一代生長初期之苗高有抑制影響外，對收穫前的各量性狀之影響不顯明。

在X線處理後代中發現矮稻，該稻較原來品種株高低矮，穗短而小，粒小而密，結實爲正常。矮稻出現後不再有分離現象，故此種突變體爲已固定者。爲明瞭矮稻發生之機構及其遺傳行爲，曾將之與原來品種雜交，在 F2 分離出正常稻與矮稻，其比例符合於理論値 3:1 之比率，由此而觀，矮稻可能由於因子之劣變所致。

處理後代所生的半不稔稻自交後分離爲結實稻及半不稔稻，其比例爲 1:1。結實率高者不再有分離現象，但半不稔稻復以 1:1 之比例分離出結實稻與半不稔稻兩種，以後之分離情形相同。此種結實率表示不連續變異之系統以細胞遺傳之觀察結果，已知由於染色體構造變化所致。對於結實率表示連續變異者，所包括的機構較複雜，詳細情形尙待研究。

馬鈴薯種薯供應試驗

第一報　應用2—氯乙烯及硫氰銨催醒馬鈴薯休眠芽之初步研究

郭　國　柱

一、緒　　言

馬鈴薯爲茄科植物，其地下球莖可供食用，爲主要蔬菜之一，同時亦可供製澱粉，酒精等。並可爲家畜飼料之用。故亦可謂重要作物之一。

本省馬鈴薯種薯每年自日本輸入，年達數十萬公斤之多，此種作物在本省中北部均可栽培。然其現栽培面積頗小，且歷年來栽培面積變化甚大（參考農林廳發行之"臺灣農業年報"）。其原因雖多，但最主要者爲馬鈴薯種薯之供應問題。解決之道，自不單純，但綜合其重點可歸納爲三：1. 栽培地區之配合問題。2. 栽培季節之配合問題。3. 栽培技術之研究問題。

本試驗卽爲上述第2點栽培季節配合問題中之一部分。最先遭遇到的困難是種薯休眠的問題。馬鈴薯休眠之長短，依品種之不同，栽培地區和時期之不同及溫濕度的不同而有差異。據日人"小田鬼八"氏之報告馬鈴薯"男爵"(Irish cobler) 品種，在日本夏季休眠期爲74日，秋季爲 120 日。Early Rose 品種，夏季爲60日，秋季爲 100 日又據田原芳範氏之試驗報告，在本省馬鈴薯之休眠期"男爵"種在1月8日收穫者約爲3個月，在2月10日至5月10日間收穫者約爲 2.5 個月，在12月8日收穫者約爲 3.5 個月。由此可知馬鈴薯之休眠期，常因氣溫之高低，而有差異，在高溫時休眠期比低溫時爲短。據日本長野縣之報告：在 4°C 時休眠期爲 125 日，10°C 時爲 90日，20°C 時爲75日。故要解決栽培季節之配合問題，必先解決休眠期之問題。

在栽培季節之配合問題的解決途徑上，可應用一年兩期栽培。卽在春秋兩季種植。秋季所用之種薯卽應用當年春季所採收者，春植者所用之種薯係秋季生產者，休眠期經過低溫，在種植時難免不發生發芽延遲，或發芽不整齊之現象，而影響馬鈴薯之生長。因此催醒休眠芽之研究甚屬必要其價值亦大。

又馬鈴薯栽培過程中最難控制之毒素病，在種薯外觀甚難鑑別。如欲把握下期作的收穫，必須將收穫不久之種薯預先種植，檢定其染病情形。是時亦難免受休眠期之限制。故用催芽之處理，可解決此項問題。

本試驗乃用2—氯乙烯 (Ethylene Chlorohydrin) 和硫氰銨 (Ammoniumthiocyanate) 等兩種藥劑，對于在收穫後1個月而尚在休眠期之馬鈴薯（男爵 Irish Cobler）種薯，浸漬處理，檢討藥劑之最有效而理想之使用方法。解決本省馬鈴薯種薯供應問題，有待研究之事項頗多，本試驗僅係其中一部份，以後仍擬繼續研究他種問題，以期對本省馬鈴薯種薯供應問題有所補益。

二、試驗材料及方法

A. 試驗材料：

（1）供試之馬鈴薯種薯係"男爵"種 (Irish Cobbler)，經省農會由日本引進在本所園藝系試驗，民國45年12月8日種植，46年2月26日收穫。

（2）供試之藥劑係日製之 Ethylene Chlorohydrin ($CH_2Cl \cdot CH_2OH$) 及 Ammonium

Sulphocyanate (or Ammanium thiocyanate. NH_4SCN) 等兩種。

B. 方法：

（1） 種薯的藥劑浸漬處理時期，係在民國46年 3 月27日，即收穫後經過一個月。藥劑處理後再經一個月，即在46年 4 月26日調查種薯之發芽情形。

（2） 供試馬鈴薯大小分爲兩種，大者重量爲50公分至 100 公分，小者重量爲 20 公分至 49 公分。又大小各種種薯再分爲全粒及半粒兩種。

（3） 藥劑濃度 Ethylene chlorohydrin 原液爲 80 %，使用時用清水稀釋爲 6 %溶液。Ammonium thiocyanate 爲結晶固體，使用時用清水溶解爲 1/20 濃度之水溶液。

（4） 藥劑浸漬時間分爲兩種，一爲浸漬24小時，另爲浸漬 1 小時。

（5） 藥劑浸漬後取出，再分下列 5 種處理。

①即刻種植于砂床者。

②經48小時密閉後種植于砂床者。

③經48小時密閉後置于屋內者。

④經48小時置于屋內（不密閉）後種植于砂床者。

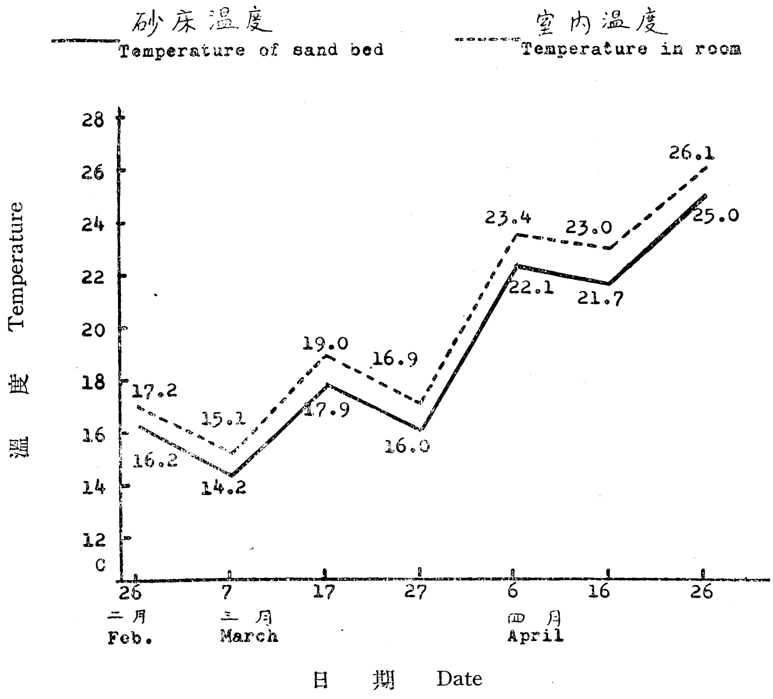
⑤取出後卽置于屋內者。

（6） 對照區分爲兩種，即種植于砂床及置于屋內者。

（7） 試驗期間內砂床及屋內之溫度如下。

圖 1：試驗期間溫度曲線圖

Fig. 1 Temperature in period of experiment



三、試 驗 結 果

表1：應用6％"2—氯乙烯"浸漬24小時處理試驗成績

Table 1 The result of the treatment with 6% Ethylene Chlorohydrin solution for 24 hours.

代號 No. of treat-ment	種薯類別 Kind of Tubers		藥劑浸漬後種薯處理類別 The Kinds of treatment after soaking chemical solution	種薯腐爛百分率 Percentage of decay tuber	未腐爛而無發芽薯百分率 Percentage of non-budding no dacay tuber	發芽薯百分率 Percentage of budding tuber	每粒種薯平均芽數 av. no. of buds of each tuber	平均芽長 av. length of bud
				%	%	%	個	cm
A 1 甲	大薯全粒	large whole tuber	取出後即刻種植于砂床 Planted in sand bed immediately	40	20	40	6.5	1.20
A 1 乙	大薯半粒	large halfr tube		100	0	0	0	—
A 1 丙	小薯全粒	small whole tuber		20	80	0	0	—
A 1 丁	小薯半粒	small half tuber		100	0	0	0	—
A 2 甲	大薯全粒	large whole tuber	取出後經密閉48小時再種植于砂床 Planted in sand bed after air tight closed 48 hrs.	20	80	0	0	—
A 2 乙	大薯半粒	large half tuber		100	0	0	0	—
A 2 丙	小薯全粒	small whole tuber		40	60	0	0	—
A 2 丁	小薯半粒	small half tuber		100	0	0	0	—
A 3 甲	大薯全粒	large whole tuber	取出後經密閉48小時然後置于屋內 Placed in the room after air tight closed 48 hrs.	0	0	100	6.4	0.62
A 3 乙	大薯半粒	large half tuber		100	0	0	0	—
A 3 丙	小薯全粒	small whole tuber		0	0	100	6.4	0.62
A 3 丁	小薯半粒	small half tuber		100	0	0	0	—
A 4 甲	大薯全粒	large whole tuber	取出後置于屋內經48小時再種植于砂床 Planted in sand bed after placed in room 48 hrs.	0	40	60	2.0	1.30
A 4 乙	大薯半粒	large half tuber		100	0	0	0	—
A 4 丙	小薯全粒	small whole tuber		20	20	60	5.2	0.41
A 4 丁	小薯半粒	small half tuber		100	0	0	0	—
A 5 甲	大薯全粒	large whole tuber	取出後置于屋內不種植 Placed in the room	0	20	80	5.0	0.81
A 5 乙	大薯半粒	large half tuber		100	0	0	0	—
A 5 丙	小薯全粒	small whole tuber		0	40	60	2.3	0.13
A 5 丁	小薯半粒	small half tuber		100	0	0	0	—
CK1甲	大薯全粒	large whole tuber	種植于砂床之對照區 CK. Planted in sand bed	0	100	0	0	—
CK1乙	大薯半粒	large half tuber		0	100	0	0	—
CK1丙	小薯全粒	small whole tuber		0	100	0	0	—
CK1丁	小薯半粒	small half tuber		0	100	0	0	—
CK2甲	大薯全粒	large whole tuber	置于屋內之對照區 CK. Placed in the room	0	100	0	0	—
CK2乙	大薯半粒	large half tuber		0	100	0	0	—
CK2丙	小薯全粒	small whole tuber		0	100	0	0	—
CK2丁	小薯半粒	small half tuber		0	100	0	0	—

根據（表一）對照區無論種植于砂床或置于屋內，不分種薯類別，均未發芽亦無腐爛。用 6 % Ethylene Chlorhydrin 水溶液浸漬24小時處理者，其種薯不分大小，切開爲半粒之 A_1 乙，A_1 丁，A_2 乙，A_2 丁，A_3 乙，A_3 丁，A_4 乙，A_4 丁，A_5 乙，A_5 丁等各區之腐爛薯數均達 100%，然全粒者其腐爛率較低。尤其 A_3 甲，A_3 丙等兩區全無腐爛。依此可知用本法處理時，種薯不應切開，否卽 全部腐爛。依本試驗目的之催芽成績而觀，發芽種薯百分率以 A_3 甲，A_3 丙等兩區成績最佳，達 100 %之發芽率。A_5 甲，區次之，爲80%。再次者 A_4 甲，A_4 丙，A_5 丙等三區爲60%。A_1 甲區僅爲40%發芽率，其應用價值較差。A_1 丙，A_2 甲，A_2 丙等三區均未見發芽，至于每粒種薯平均芽數，以 A_1 甲爲最多，平均爲 6.5 芽；次者爲 A_3 甲區及 A_3 丙區，均爲 6.4 芽。又每芽之平均長度以 A_4 甲區爲最長，平均 1.3 公分。次者爲 A_1 甲區，平均爲 1.2 公分。

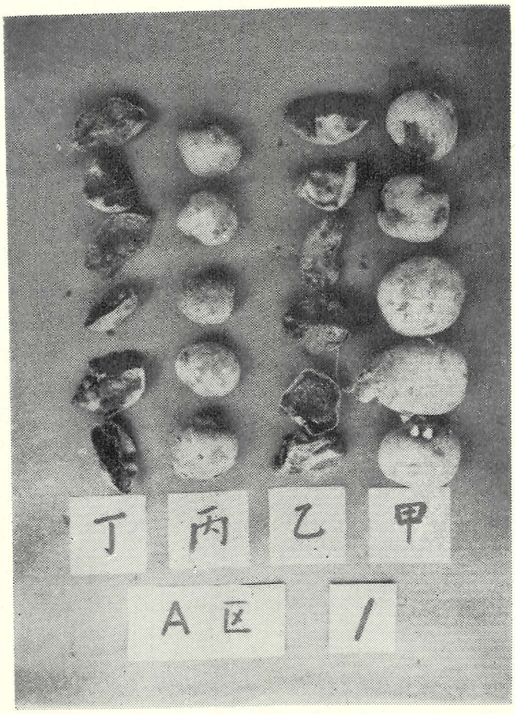


圖 2： 應用 6 % 2 一氯乙烯浸漬24小時處理取出後卽刻種植于砂床之各區成績

Fig. 2 Planted in sand bed after soaking 6% Ethylene Chlorohydrin solution for 24 hours

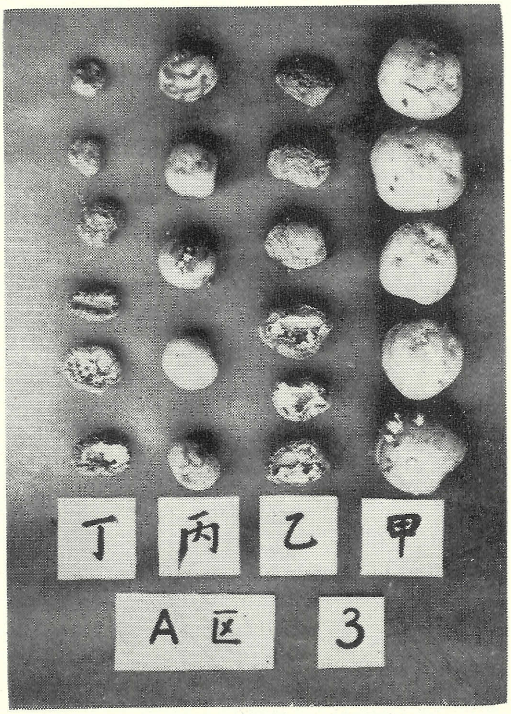


圖 3： 應用 6 % 2 一氯乙烯浸漬24小時處理取出後經密閉48小時然後置于屋內之各區成績

Fig. 3 First soaking 6 % Ethylene Chlorohydrin solution for 24 hours then air tight closed 48 hours and placed in the room

表2：應用6%"2—氯乙醇"浸漬1小時處理試驗成績

Table 2 The result of the treatment with 6% Ethylene Chlorlhydrin solution for 1 hour.

代號 No. of treatment	種薯類別 Kind of Tubers	藥劑浸漬後種薯處理類別 The Kinds of treatment after soaking chemical solution	種薯腐爛百分率 Percentage of decay tuber	未腐爛而無發芽薯百分率 Percentage of non-budding no dacay tuber	發芽薯百分率 Percentage of budding tuber	每粒種薯平均芽數 av. no. of buds of each tuber	平均芽長 av. length of bud
			%	%	%	個	cm
B 1甲	大薯全粒 large whole tuber	取出後即刻種植于砂床 Planted in sand bed immediately	0	60	40	3.5	0.50
B 1乙	大薯半粒 large half tuber		100	0	0	0	—
B 1丙	小薯全粒 small whole tuber		0	80	20	3.0	1.20
B 1丁	小薯半粒 small half tuber		100	0	0	0	—
B 2甲	大薯全粒 large whole tuber	取出後經密閉48小時再種植于砂床 Planted in sand bed after air tight closed 48 hrs.	40	0	60	3.3	1.66
B 2乙	大薯半粒 large half tuber		100	0	0	0	—
B 2丙	小薯全粒 small whole tuber		0	40	60	4.0	0.80
B 2丁	小薯半粒 small half tuber		100	0	0	0	—
B 3甲	大薯全粒 large whole tuber	取出後經密閉48小時然後置于屋內 Placed in the room after air tight closed 48 hrs.	0	20	80	3.0	1.25
B 3乙	大薯半粒 large half tuber		83.3	0	16.7	3.0	0.40
B 3丙	小薯全粒 small whole tuber		0	0	100	3.4	0.11
B 3丁	小薯半粒 small half tuber		83.3	16.7	0	0	—
B 4甲	大薯全粒 large whole tuber	取出後置于屋內經48小時再種植于砂床 Planted in sand bed after placed in room 48 hrs.	0	0	100	2.6	1.60
B 4乙	大薯半粒 large half tuber		100	0	0	0	—
B 4丙	小薯全粒 small whole tuber		20	40	40	1.0	0.20
B 4丁	小薯半粒 small half tuber		100	0	0	0	—
B 5甲	大薯全粒 large whole tuber	取出後置于屋內不種植 Placed in the room	0	100	0	0	—
B 5乙	大薯半粒 large half tuber		100	0	0	0	—
B 5丙	小薯全粒 small whole tuber		0	100	0	0	—
B 5丁	小薯半粒 small half tuber		100	0	0	0	—
CK1甲	大薯全粒 large whole tuber	種植于砂床之對照區 CK. Planted in sand bed	0	100	0	0	—
CK1乙	大薯半粒 large half tuber		0	100	0	0	—
CK1丙	小薯全粒 small whole tuber		0	100	0	0	—
CK1丁	小薯半粒 small half tuber		0	100	0	0	—
CK2甲	大薯全粒 large whole tuber	置于屋內之對照區 CK. Placed in the room	0	100	0	0	—
CK2乙	大薯半粒 large half tuber		0	100	0	0	—
CK2丙	小薯全粒 small whole tuber		0	100	0	0	—
CK2丁	小薯半粒 small half tuber		0	100	0	0	—

根據（表二）對照區仍均無發芽亦無腐爛。本處理乃按上法所用之 6 % Ethylene Chlorohydrin 水溶液，浸漬時間縮短爲 1 小時。其結果切開爲半粒種薯腐爛率除 B_3 乙，B_3 丁等兩區爲 83.3%稍見減低外，B_1 乙，B_1 丁，B_2 乙，B_4 丁，B_4 乙，B_5 丁，B_5 乙，B_5 丁等各區腐爛率均爲 100 %，然全粒者以 B_4 丙區腐爛率爲 20 %外，其餘各區全不腐爛。本法處理時仍以不切開浸漬爲佳。否即全部腐爛。藥劑處理後之種薯發芽率以 B_3 丙，B_4 甲兩區爲最佳均爲 100%。次者爲80%發芽率之 B_3 甲區。再次者爲 B_2 甲，B_2 丙等兩區其發芽率爲 60%。B_1 甲區及 B_4 甲區僅有40%發芽率。B_1 丙區爲20%，B_5 甲及 B_5 丙區全不發芽，應用價值較差。每粒種薯平均發芽數以 B_2 丙區之 4.0 芽爲最多。次爲 B_1 甲區之 3.5 芽，B_3 丙區之 3.4 芽，B_2 甲區之 3.3 芽，再者爲 B_1 丙區，B_3 甲區，B_2 乙區等之 3.0 芽，B_4 甲區爲 2.6 芽，B_4 丙區爲 1.0 芽。每芽之長度以 B_2 甲區之 1.66 公分爲最長，次者爲 B_4 甲區之 1.60 公分，再次者爲 B_3 甲區之 1.25 公分，B_1 丙區之 1.20 公分。

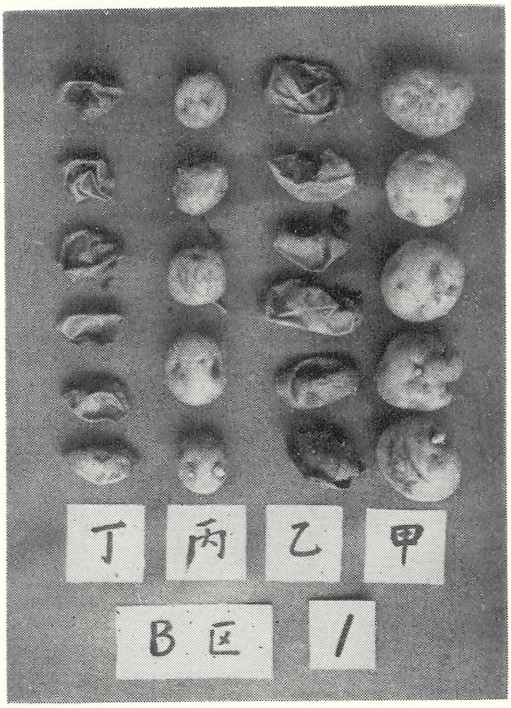


圖 4： 應用 6 % 2 一氯乙烯浸漬 1 小時處理取出後即刻種植于砂床之各區成績

Fig. 4 Planted in sand bed after soaking 6% Ethylene Chlorohydrin solution for 1 hour

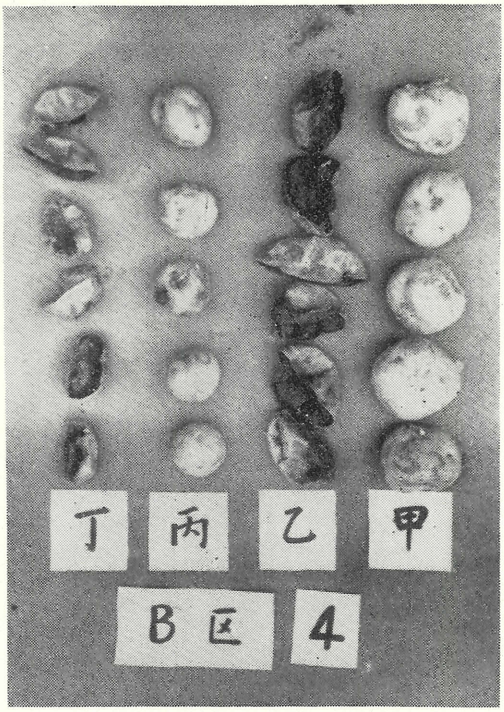


圖 5： 應用 6 % 2 一氯乙烯浸漬 1 小時處理取出後置于屋內經48小時再種植于砂床之各區成績

Fig. 5 First soaking 6 % Ethylene Chlorohydrin solution for 1 hour then placed in the room for 48 hours and planted in sand bed

表 3：應用1/120 "硫氰銨" 浸漬24小時處理試驗成績

Table 3 The result of the treatment with 1/120 Ammonium thiocyanate solution for 24 hours.

代號 No. of treatment	種薯類別 Kind of Tubers		藥劑浸漬後種薯處理類別 The Kinds of treatment after soaking chemical solution	種薯腐爛百分率 Percentage of decay tuber	未腐爛而無發芽薯百分率 Percentage of non-budding no dacay tuber	發芽薯百分率 Percentage of budding tuber	每粒種薯平均芽數 av. no. of buds of each tuber	平均芽長 av. length of bud
				%	%	%	個	cm
C 1甲	大薯全粒	large whole tuber	取出後即刻種植于砂床 Planted in sand bed immediately	40	60	0	0	—
C 1乙	大薯半粒	large half tuber		16.7	0	83.7	1.2	3.20
C 1丙	小薯全粒	small whole tuber		20	60	20	6.0	0.50
C 1丁	小薯半粒	small half tuber		50	0	50	3.6	1.16
C 2甲	大薯全粒	large whole tuber	取出後經密閉48小時再種植于砂床 Planted in sand bed after air tight closed 48 hrs.	20	20	60	8.0	0.20
C 2乙	大薯半粒	large half tuber		0	0	100	2.5	1.41
C 2丙	小薯全粒	small whole tuber		20	20	60	3.6	0.20
C 2丁	小薯半粒	small half tuber		0	0	100	3.0	1.05
C 3甲	大薯全粒	large whole tuber	取出後經密閉48小時然後置于屋內 Placed in the room after air tight closed 48 hrs.	0	100	0	0	—
C 3乙	大薯半粒	large half tuber		83.3	16.7	0	0	—
C 3丙	小薯全粒	small whole tuber		0	100	0	0	—
C 3丁	小薯半粒	small half tuber		83.3	16.7	0	0	—
C 4甲	大薯全粒	large whole tuber	取出後置于屋內經48小時再種植于砂床 Planted in sand bed after placed in room 48 hrs.	0	80	20	1.0	0.10
C 4乙	大薯半粒	large half tuber		0	0	100	1.8	1.60
C 4丙	小薯全粒	small whole tuber		0	80	20	1.0	0.30
C 4丁	小薯半粒	small half tuber		0	0	100	1.6	1.93
C 5甲	大薯全粒	large whole tuber	取出後置于屋內不種植 Placed in the room	0	100	0	0	—
C 5乙	大薯半粒	large half tuber		83.3	16.7	0	0	—
C 5丙	小薯全粒	small whole tuber		0	100	0	0	—
C 5丁	小薯半粒	small half tuber		100	0	0	0	—
CK1甲	大薯全粒	large whole tuber	種植于砂床之對照區 CK. Planted in sand bed	0	100	0	0	—
CK1乙	大薯半粒	large half tuber		0	100	0	0	—
CK1丙	小薯全粒	small whole tuber		0	100	0	0	—
CK1丁	小薯半粒	small half tuber		0	100	0	0	—
CK2甲	大薯全粒	large whole tuber	置于屋內之對照區 CK. Placed in the room	0	100	0	0	—
CK2乙	大薯半粒	large half tuber		0	100	0	0	—
CK2丙	小薯全粒	small whole tuber		0	100	0	0	—
CK2丁	小薯半粒	small half tuber		0	100	0	0	—

觀（表三）對照區亦均未發芽又無腐爛。在本試驗中腐爛薯數百分率最高者為 C_5 丁區之 100 %，次者為 C_3 乙區，C_3 丁區，C_5 乙區之 83.3 %。全無腐爛者有 C_2 乙區，C_2 丁區，C_3 甲區，C_3 丙區，C_4 甲區，C_4 乙區，C_4 丙區，C_4 丁區，C_5 甲區，C_5 丙區等。經處理種薯發芽率最高者為 C_2 乙區，C_2 丁區，C_4 乙區，C_4 丁區等，均為 100 %。此等區均係切開為半粒者。每粒種薯平均發芽數以 C_2 甲區之 8.0 芽為最多。次者為 C_1 丙區之 6.0 芽。平均芽長以 C_1 乙區之 3.2 公分為最長。

照本試驗觀之，倘用 1/120 Ammonium thiocyanate 水溶液浸漬24小時處理時，使用之種薯大小均可，但均以切開為半粒為佳。而浸漬後取出經密閉或放置48小時然後種植于砂床者，催芽效果最高。

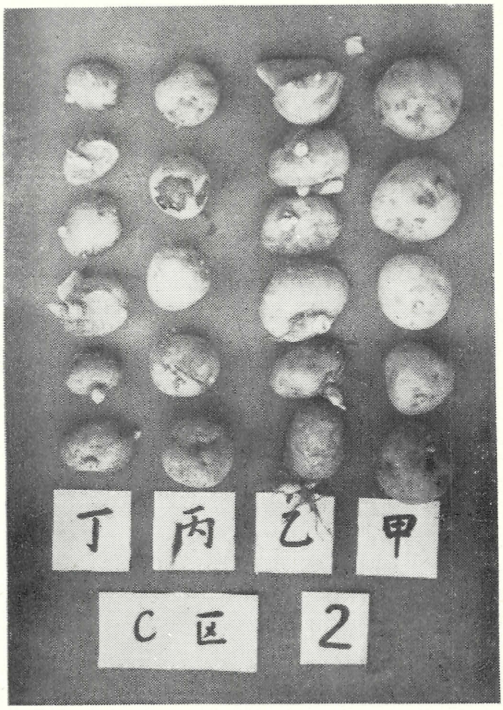


圖 6： 應用 1/120 硫氰銨浸漬24小時處理取出後經密閉48小時再種植于砂床之各區成績

Fig. 6 First soaking 1/120 Ammonium thiocyanate solution for 24 hours then air tight closed 48 hours and planted in sand bed

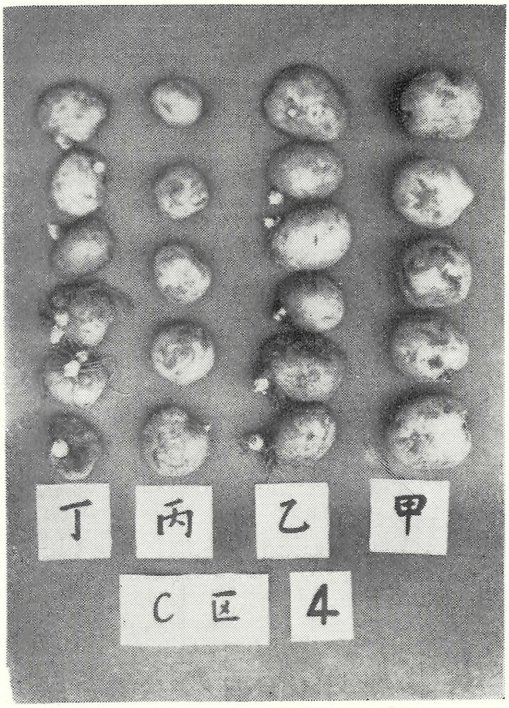


圖 7： 應用 1/120 硫氰銨浸漬24小時處理取出後置于屋內經48小時再種植于砂床之各區成績

Fig. 7 First soaking 1/120 Ammonium thiocyanate solution for 24 hours then placed in the room for 48 hours and planted in sand bed

表4：應用1/120“硫氰銨”浸漬1小時處理試驗成績

Table 4 The resultof the treatment with 1/120 Ammonium thiocyanate solution for 1 hour.

代號 No. of treat-ment	種薯類別 Kind of Tubers	藥劑浸漬後種薯處理類別 The Kinds of treatment after soaking chemical solution	種薯腐爛百分率 Perce-ntage of decay tuber	未腐爛而無發芽薯百分率 Perce-ntage of non-budding no decay tuber	發芽薯百分率 Perce-ntage of budding tuber	每粒種薯平均芽數 av. no. of buds of each tuber	平均芽長 av. length of bud
			%	%	%	個	cm
D 1 甲	大薯全粒 large whole tuber	取出後即刻種植于砂床 Planted in sand bed immediately	0	20	80	2.5	0.38
D 1 乙	大薯半粒 large half tuber		0	0	100	1.0	6.00
D 1 丙	小薯全粒 small whole tuber		40	60	0	0	—
D 1 丁	小薯半粒 small half tuber		0	0	100	1.0	6.30
D 2 甲	大薯全粒 large whole tuber	取出後經密閉48小時再種植于砂床 Planted in sand bed after air tight closed 48 hrs.	40	40	20	2.0	1.50
D 2 乙	大薯半粒 large half tuber		0	0	100	1.2	4.28
D 2 丙	小薯全粒 small whole tuber		20	80	0	0	—
D 2 丁	小薯半粒 small half tuber		0	0	100	2.1	3.30
D 3 甲	大薯全粒 large whole tuber	取出後經密閉48小時然後置于屋內 Placed in the room after air tight closed 48 hrs.	20	40	40	3.0	0.10
D 3 乙	大薯半粒 large half tuber		0	100	0	0	—
D 3 丙	小薯全粒 small whole tuber		0	60	40	1.5	0.15
D 3 丁	小薯半粒 small half tuber		33.3	66.7	0	0	—
D 4 甲	大薯全粒 large whole tuber	取出後置于屋內經48小時再種植于砂床 Planted in sand bed after placed in room 48 hrs.	0	100	0	0	—
D 4 乙	大薯半粒 large half tuber		0	0	100	1.3	2.33
D 4 丙	小薯全粒 small whole tuber		0	100	0	0	—
D 4 丁	小薯半粒 small half tuber		0	0	100	1.6	3.35
D 5 甲	大薯全粒 large whole tuber	取出後置于屋內不種植 Placed in the room	0	100	0	0	—
D 5 乙	大薯半粒 large half tuber		33.3	66.7	0	0	—
D 5 丙	小薯全粒 small whole tuber		0	100	0	0	—
D 5 丁	小薯半粒 small half tuber		0	100	0	0	—
CK1甲	大薯全粒 large whole tuber	種植于砂床之對照區 CK. Planted in sand bed	0	100	0	0	—
CK1乙	大薯半粒 large half tuber		0	100	0	0	—
CK1丙	小薯全粒 small whole tuber		0	100	0	0	—
CK1丁	小薯半粒 small half tuber		0	100	0	0	—
CK2甲	大薯全粒 large whole tuber	置于屋內之對照區 CK. Placed in the room	0	100	0	0	—
CK2乙	大薯半粒 large half tuber		0	100	0	0	—
CK2丙	小薯全粒 small whole tuber		0	100	0	0	—
CK2丁	小薯半粒 small half tuber		0	100	0	0	—

按（表四）觀之，用 1/120 Ammonium thiocyanate 水溶液經過1小時浸漬處理者，各區腐爛數較少，最高者有 D_1 丙區，D_2 甲區等兩區爲40%，次者爲 D_3 丁區，D_5 乙區等兩區之 33.3 %，又 D_2 丙區及 D_3 甲區等兩區腐爛率爲 20 %。其餘各區均無腐爛。發芽率以種植于砂床之切開爲半粒區爲最佳，均爲 100 %。全粒區及不種植于砂床而置于屋內者，其發芽率較差。即除 D_1 甲區爲80%，D_3 甲區及 D_3 丙區爲 40%，D_2 甲區爲 20%發芽率外，其他各區均不發芽。至于每粒種薯平均芽數，以 D_3 甲區之 3.0 芽爲最高，次爲 D_1 甲區之 2.5 芽。平均芽長以 D_1 丁區之 6.3 公分爲最長，D_2 乙區之 4.28 公分爲次者：

綜合上述結果，倘用本法處理時，種薯大小與結果似無大關係，但必須切開處理。又處理後應種植于砂床，否者其發芽率較差。

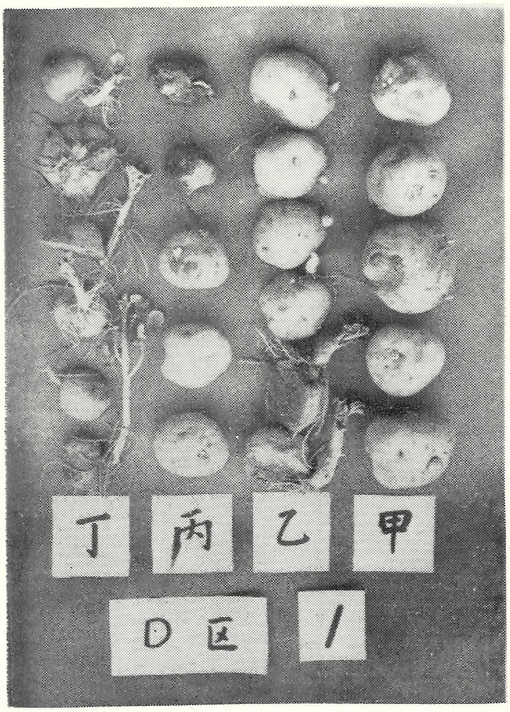


圖 8： 應用 1/120 硫氰銨浸漬 1 小時處理取出後即刻種植于砂床之各區成績

Fig. 8 Planted in sand bed after soaking 1/120 Ammonium thiocyanate solution 1 hour

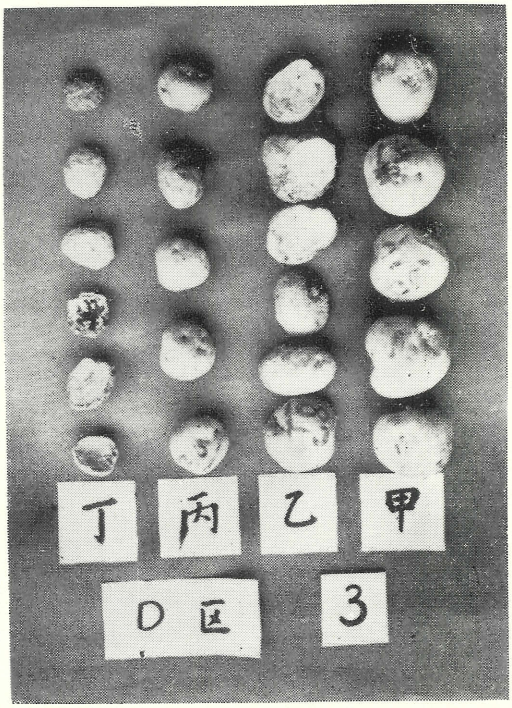


圖 9： 應用 1/120 硫氰銨浸漬 1 小時處理取出後經密閉48小時然後置于屋內之各區成績

Fig. 9 First soaking 1/120 Ammonium thicyanate solution for 1 hour then air tight closed 48 hours and placed in the room.

四、檢　　　討

本試驗乃爲 6 % Ethylene Chlorohydrin 水溶液及 1/120 Ammonium thiocyanate 水溶液兩種藥劑，以24小時及1小時兩種時間浸漬，和使用大小兩種之全粒及半粒種薯，做比較試驗。綜合以上試驗記載之結果，馬鈴薯種薯之催芽，使用種薯大小無須選擇，但使用全粒及半粒之分別，大有差異。用 Ethyene Chlorohydrin 浸漬時，種薯以不切開者爲佳。用 Ammonium thiocyanate

浸漬時，用全粒者其發芽率較低，切開爲半者始可得理想之催芽率。使用 Ethylene Chlorohydrin 水溶液浸漬種薯時間之長短無大差異。用 Ammonium thiocyanate 水溶液浸漬時，其時間以 1 小時爲適合。至于浸漬後之處置，使用 Ethylene Chlorohydrin 浸漬者，浸漬24小時區，將浸漬後取出經過48小時密閉後置于屋內者較爲理想。又浸漬1小時區者，除如上述方法可得良好成績外，將取出後放置于屋內經過 48 小時再種植于砂床者其成績亦良好。使用 Ammonium thiocyanate 浸漬者，種植于砂床之各區成績，均見良好。

至于馬鈴薯種薯收穫後經過期間之長短與催芽之功效，經催芽後所生之種種影響，催芽藥劑使用方法與經濟價值之問題等等，必需瞭解之問題尚多，尙待他日繼續試驗。

五、摘　　　要

本試驗之主要結果摘錄如下。

（一） 採收後經過一個月之馬鈴薯休眠種薯，使用 $1/_{120}$ Ammonium thiocyanate 水溶液浸漬 1 小時，可得80%至 100 %之催芽效果。

（二） 使用 $1/_{120}$ Ammonium thiocyanate 催芽時無論種薯大小均須切開爲半粒而浸漬處理，浸漬後並需種植，始可得良好結果。

（三） 催芽時使用 6 % Ethylene Chlorohydrin 水溶液者，比使用$1/_{120}$ Ammonium thiocyanate 水溶液者效果爲差。

（四） 倘使用 6 % Ethylene Chlorohydrin 水溶液浸漬催芽時，種薯不可切開浸漬，否則容易腐爛。

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EXPERIMENT ON SEED POTATO SUPPLY

(I) THE PRIMARY STUDY OF USING AMMONIUM THIOCYANATE AND ETHYLENE CHLOROHYDRIN TO BREAK TUBER DORMANCY OF SEED POTATO

by

KUO-CHU KUO

SUMMARY

1. The dormant seed potatoes after one month from harvest can obtain 80 to 100 per cent effect of forcing germination by soaking them into 1/120 Ammonium Thiocyanate solution for one hour.

2. When using Ammonium Thiocyanate for forcing germination regardless the size of seed potato, all must be cut half for soaking and have to plant after soaking then good result can be obtained.

3. The forcing germination effect of 6% Ethylene Chlorohydrin solution is less than 1/120 Ammonium Thiocyanate solution.

4. By using 6% Ethylene Chlorohydrin solution to forcing germination, the seed potato may not be cut off for soaking, or it would rot easily.

CONTROL OF PADDY BORER ON THE SECOND RICE CROP IN 1957

by

CHIA-HWA TAO,

Paddy borer (Schoenobius incertellus WK) has been a serious pest of the rice crops in the Southern part of Taiwan. It has five or six generations in a year. The second rice crop is destroyed by two generations, namely the fourth and fifth. They attack this crop from seedling to maturity. Heavy infestation of paddy borer in the fields usually occurs every year. Resent test by the writer from 1953 to 1956 has given hope for controlling this pest with certain insecticides. During the summer of this year the writer was provided an opportunity to retest some of the insecticides and untried materials for paddy borer control and these were compared with gusation. The results obtained by chemical control are here summarized.

Methods.—The field trials were carried out at Shang-tzu-ting in chia-yi county in 1957. The field experiments were divided into four blocks of 12 plots each. Plots measured 5×5 meters including 500 hills, each plot had 20 rows making 25 hills per row. The plant was 25 cm by 20 cm apart. The variety of rice which was used is Chia-yoh No. 242. It was transplanted on August 3. Ten different treatments and two checks were assigned at random to each block. Treatments consisted of 2 concentrations of endrin 0.02% and 0.04%; 2 concentrations of folidol 0.02% and 0.04%; 2 concentrations of gusathion 0.02% and 0.04%; 2 concentrations of trithion 0.02% and 0.04%; and 2 concentrations of methyl parathion 0.02% and 0.04%. The percentage of dead seedling was determing by examing 150 hills randomly selected from central rows of each plot at seven days after first spraying and the percentage of empty panicle or white head was counted by examing 150 hills at random from central rows of each plot at two weeks before harvest.

Sprays were made from emulsifiable concentrate and applied with a small type of automatic sprayer. Application of insecticides was made on Sept. 6, since the fourth generation of borer attacked seedling during growth stage. The rate of application was 800 liters per hectare and the spray was followed by a second spray on Sept. 30 and a third on Oct. 5, since the fifth generation of borer started to attack the booting stage or youngest panicle stage, the rate of application was increased to 1,200 liters of insecticidal solution per hectare in the last two treatments.

Results.—All treatments showed significant difference over the control. There was also a significant between the insecticides and concentrations. According to the yield of treated plots, endrin, gusathion and folidol were about equal in effective results giving excellent control of this pest. Endrin and gusathion were better than folidol and

trithion in controlling this pest, but methyl parathion was least against this pest in the treatments as shown in table 1.

Table 1.—Effective Control of Paddy Borer on The Second Rice Crop in 1957

Chemical Treatments	Dead Seedlings		Empty Panicles		Yield of Rice kg/ha	Index
	Percent (AV)	Angle	Percent (AV)	Angle		
0.02% Endrin emulsion	2.84	9.65	7.25	15.85	5,280.00	120.82
0.04% Endrin emulsion	1.75	7.52	3.50	10.49	6,040.00	138.24
0.02% Folidol emulsion	2.45	8.97	9.27	17·71	5,080.00	116.25
0.04% Folidol emulsion	1.76	7.45	5.18	12.59	5,720.00	130.00
0.02% Gusathion emul.	2.83	9.64	6.35	14.57	5,360.00	122.65
0.04% Gusathion emul.	1.45	6.90	5.57	13.58	5,800.00	132.72
0.02% Trithion emul.	3.63	10.95	8.24	16.49	5,200.00	119.00
0.04% Trithion emul.	1.35	6.64	7.37	15.54	5,440.00	124.50
0.02% Methyl parathion E.	4.10	11.60	9.80	18.17	4,840.00	110.80
0.04% Methyl parathion E.	2.75	9.52	8.05	16.49	5,160.00	118.10
Check (Untreated)	6.28	14.50	11.87	20.72	4,370.00	100.00
L. S. D. at 5% Level		2.08		3.15	343.68	
L. S. D. at 1% Level		2.79		4.23	459.80	

Discussion.—According to table 1, percentage of dead seedling in the treated plots was 1.35% to 4.10% as compared with 6.28% in the check. Percentage of empty panicle or white head was 3.50% to 9.80% in the treated plots as compared with 11.87% in the untreated plots. Yield of treated plots was 4,840 to 6,040 kilograms of rice as compared with 4,370 kilograms in the check per hectare or an increase of 470 to 1,670 kilograms of rice per hectare. Although all treated plots were more significant than the check, the high concentrated sprays proved better results than the low ones. Endrin and gusathion were found to be most effective in controlling this pest. In all treated plots 0.04% concentrated sprays were about equal in effectiveness against this pest except trithion and methyl parathion. These were not as effective as the others, but trithion was better than methyl parathion.

Summary.—Endrin, gusathion, folidol, trithion, and methyl parathion were tested for control of the paddy borer (Schoenobius incertellus WK) infesting the second rice crop at Shang-tzu-ting in Chia-yi county in 1957.

1. In the treated plots, the percentage of dead seedling and empty panicle were lower than the check. and there were also significant difference between insecticides and concentrated used
2. Yield of rice receiving treatments was higher than that on the untreated plots, but there was significant difference between insecticides and concentrated sprays. Endrin and gusathion gave the best results in controlling this species, as the index of yield were at 20.82% to 38.24%; and 22.65% to 32.72%; in the folidol

treated plots as index of yield was 16.25% to 30.00%; in the trithion treated plots as index of yield was 19.00% to 24.50%, in the methyl parathion treated plots as index of yield was 10.80% to 18.10%, therefore the methyl parathion was least effective in controlling this pest in these experiments.

1957 年防治二期作水稻三化螟蟲試驗

陶　家　驊

摘　要

在嘉義山子頂舉行二期作防治三化螟蟲試驗，參加殺蟲劑爲 19.5% Endrin, 20% Gusathion, 46.6% Folidol, 37% Trithion 和 44.5% Methyl parathion 等五種乳劑。

（1） 施藥區與對照區禾苗枯心率和白穗率之差異，均屬顯著，藥劑和濃度間之差異，亦屬顯著。

（2） 施藥區與對照產量之差異，頗爲顯著，藥劑和濃度間之差異，尙屬顯著。各試驗區之產量指數 Endrin 20.82～38.24% 及 Gusathion 22.65～32.72%最高。Folidol 16.25～30.00%及 Trithion 19.00～24.50%次之，Methyl parathion 10.80～18.10%最低。本試驗中治螟成效，就產量而言，Endrin 和 Gusathion 乳劑最優，Folidol 和 Trithion 乳劑次之，但 Methyl parathion 乳劑最劣。

誌謝：本試驗期中承楊所長致福督促和鼓勵；王技士茂康惠允撥給試驗地及協助水稻栽培；農復會劉博士廷蔚惠贈殺蟲劑。又承本系同仁湯慶銓和余健敏兩君協助調查和分析，文成後，復蒙總所應用動物系陶技正家駒撥冗校閱，均此敬誌謝忱。

螞蟻與鳳梨粉介殼蟲萎凋病關係之研究

孫 守 恭

一、緒 言

鳳梨萎凋病，不僅爲臺灣鳳梨之嚴重病害[14,16]，亦世界各地鳳梨產業之尅星[1,7]一向爲鳳梨業者所注意。關於鳳梨萎凋病之起因，早經夏威夷諸學者先後證明爲鳳梨粉介殼蟲 (Dysmicoccus brevipes Ckl.) 爲害所引起[1,6,7]。臺灣之鳳梨萎凋病，雖將吾人困惑於一時，亦已數度證實爲鳳梨粉介殼蟲所引起[14,16,17]；且鳳梨粉介殼蟲在臺灣各地爲害情形，已至無以復加之程度[19]，久爲臺灣鳳梨事業發展之障碍。自民國四十一年筆者等以有機燐類殺蟲劑防治該蟲[21]，以預防萎凋病之發生，數年來在南部各地示範、推廣、以至大規模防治，效果均甚卓越，萎凋病亦顯著減少。

粉介殼蟲之爲害鳳梨，係該蟲分泌一種毒汁 (Nonliving toxic substance)，使鳳梨根系崩潰死亡，因而地上部乃現萎凋[1,4]。此種毒汁分泌之量與引起萎凋之程度，在有限度範圍以內，與粉介殼蟲之數目，略成比例增加[2,3]。且粉介殼蟲引起萎凋之能力，與其食料有密切之關係，一般言之，由雜草上轉移來者，幾不能引起萎凋，其由生育良好之鳳梨上來者，其引起萎凋之能力微弱，而寄生於生育不良或萎凋株上之粉介殼蟲，其毒性最大[5]。故鳳梨萎凋病之發生，與粉介殼蟲之數量及其來源，有極密切之關係；而此兩個因素，均與鳳梨園中之螞蟻有重要關連。

螞蟻與介殼蟲類昆蟲，一向認爲有共生之關係存在。然除極少數實例，有具體事實證明外，大部份均屬表面觀察之推想。Nixon[12] 懷疑共生 (Symbiosis) 一詞，是否恰當應用於螞蟻與介殼蟲類之偶然接合。氏謂螞蟻與介殼蟲類在某地區有密切之接合，而在其他地區則不然。Illingworth, carter 謂螞蟻增進鳳梨粉介殼蟲之活力，並爲傳佈粉介殼蟲之媒介[4,6]。在許多情況下，螞蟻可保護介殼蟲類，免受天敵之害[7,9,11,15,20]。

筆者數年來從事鳳梨萎凋病之實際防治工作，深覺鳳梨粉介殼蟲防治上之艱難。加之鳳梨係一長期作物，欲在四年之內，確保無萎凋病之發生，實屬不易。此乃筆者研究螞蟻與鳳梨粉介殼蟲及萎凋病之初衷。爰將數次試驗結果，草成此文，供有關各方之參考，並祈指正。試驗期間，簡和順先生全力協助，並蒙王分所長炘之鼓勵及農復會劉廷蔚博士審閱全文並予指示，謹一一致謝。

二、保護行種植法之再試驗

Wilson Jacobson 發現鳳梨粉介殼蟲向平行排列之鳳梨之移動，甚爲緩慢。故倡用保護行種植法[7]。保護行栽植鳳梨六列，其上經常撒佈柴油乳劑，殺死其中之粉介殼蟲，以保護本田內之鳳梨。此法在夏威夷曾大規模應用，效果頗爲顯著。

筆者採用之保護行法，與上述者同，惟目的在防治保護行上之螞蟻，以期減少粉介殼蟲之繁殖及活動，視其能否減少本田中萎凋病之發生。故其方法，與夏威夷者略有不同。

(一) 第一次試驗

材料及方法：本試驗於民國四十一年九月舉行，供試地係新墾地，種苗爲開英種鳳梨裔芽。植前均經溴化甲烷 (Methyl bromide) 燻蒸，殺除其上之粉介殼蟲。試驗區之種植法分本田，保護行及接種行。本田設於試區之中央，四周圍以保護行。本田與保護行距離二公尺，保護行種植鳳梨二行，保護行外植鳳梨一行，作爲接種行，將來在此行上接種鳳梨粉介殼蟲，作爲蟲源。

全試驗共分四處理（即四區），即 DDT 乳劑區，DDT 粉劑區，BHC 粉劑區，及對照區。接

種行接種粉介殼蟲後，保護行上及其與本田間之空地上，即行撒佈藥劑。DDT 乳劑之濃度爲 0.05%，每株以 200cc. 計撒佈之。10%DDT 粉，每株以 2 公分計，1%BHC 粉，每株以 2 公分計。每月撒佈壹次，直至採收爲止。

試驗結果：自鳳梨定植後一個月，接種行上即行接粉介殼蟲，並隨之藥劑撒佈，生育期間，隨時觀察本田內萎凋病之發生情形。

自鳳梨定植後至翌年八月，各區始有萎凋株出現。之後每兩個月調查一次，各區萎凋病率如表1。由表 1 所示，三種藥劑對於防蟻以預防萎凋之發生，均乏理想之效果。其中以DDT乳劑較好，

表 1　各區萎凋病發生百分率

Table 1. Percentage of plants wilted in each plot

處理 Treatments	萎凋率 (%) Wilt (%)					
	8 月 Aug.	10 月 Oct.	12 月 Dec.	2 月 Feb.	4 月 April	6 月 June
0.05% DDT 乳劑 0.05% DDT Emulsion	0	0.23	0.23	1.40	4.68	4.40
10% DDT 粉 2gr./株 10% DDT Dust (2gr./plant)	0.23	0.23	0.93	2.33	5.82	7.40
1% BHC 粉 2gr./株 1% BHC Dust (2gr./plant)	0.23	0.46	3.72	8.19	13.34	12.40
對照 Check	0.23	1.40	3.50	6.30	12.85	11.00

萎凋病率爲 4.4%，該區之產量亦較對照區增收 11.8%(表2)。DDT 粉與 BHC 粉均無大效果，與對照無差異。DDT 乳劑對於鳳梨粉介殼蟲之防治效力極差 [22]，其功能爲防治螞蟻。此種事實足資證明螞蟻之減少，可以遏止萎凋病之蔓延亦即抑制粉介殼蟲之活動。

表 2　各區之產量

Table 2. Yield of Each Plot

處理 Treatments	栽植株數 No. of Plants Planted	結實率(%) % of Fruiting	健全果數 No. of Healthy Fruits	健果重量 Weight of Healthy fruits(kg.)	萎凋果數 No. of Fruits Wilted	病果重量 Wt. of Wilted Fruits(kg.)	每區合計果重 Wt. of Fruits Per plot (kg.)	每公頃產量 Yield (M.T./ha)
DDT 乳劑 DDT Emulsion	427	98.83	403	712.1	19	6.0	718.1	42.04
DDT 粉劑 DDT Dust	429	93.71	376	673.8	26	8.0	681.8	39.73
BHC 粉劑 BHC Dust	427	96.93	361	625.9	53	18.0	643.9	37.70
對照 Check	428	97.43	370	630.8	47	13.0	643.8	37.60

(二)　第二次試驗

材料及方法：本試驗於四十二年十二月開始，其方法與第一次試驗同，即試驗區分本田，保護行及接種行三部份。供試地係連作地。種苗爲開英種鳳梨裔芽。植前未行燻蒸，植後以富粒多(Folidol-E 605) 千倍液，處理本田及保護行之鳳梨，每株灌 100cc 於鳳梨心部，以殺死其上可能附着之粉介殼蟲。同時以粉介殼蟲接種於接種行上，每株接20頭，隨即撒佈防蟻藥劑於保護行上及其與本田間之空地上。

本次所用之藥劑爲阿特靈 (Aldrin)，地特靈 (Dieldrin)，及 DDT 三種，均爲乳劑，濃度均爲 0.25%。每二個月撒佈一次，直至鳳梨結果爲止。

試驗期間，定期調查本田內鳳梨粉介殼之爲害率，萎凋病率及本田與保護行間空地上之螞蟻密度。

試驗結果：通常萎凋病之發生，約在鳳梨栽植後一年開始，粉介殼蟲之爲害，亦係逐漸累積，至一年後方見顯著。表 3 係自四十三年十二月至四十四年七月，調查四次之結果。由歷次調查結果，得知將防蟻藥劑撒佈於保護行上，阻止螞蟻之侵入，消除螞蟻之活動，不但可以遏止外界粉介殼蟲之侵入，且能抑制原有粉介殼蟲之繁殖，結果萎凋病之發生顯著減少。防治螞蟻以地特靈 (Dieldrin) 之效果最優，藥力最能持久。對照區內之螞蟻甚多，粉介殼蟲之爲害逐漸增加，故萎凋病亦極嚴重。充分表現螞蟻與粉介殼蟲間之相互關係。

一般在鳳梨抽穗結果後，粉介殼蟲上爬，而數量亦驟然增加。各區內均有同樣情形，此點尙待今後研究。惟此時之粉介殼蟲，均在果實上，對於萎凋病之發生，已無影響。此點在各區中均甚顯明 (表 3)。44年 7 月，各區果實均屆成熟期，粉介殼蟲多集中果實上，且數量亦多，但萎凋無顯著增加，有者反而降低。

表 4 係四區之產量統計，亦以 Dieldrin 區最高，超出對照一倍以上。

表 3 各區 (本田內) 粉介殼蟲、萎凋病及螞蟻發生情形

Table 3 Mealybug, Wilt, and Ant infestation in each plot

調查年月 Date of Survey	Aldrin		Dieldrin		DDT		Check	
	粉介殼蟲爲害率 Mealybug Infestation %	萎凋率 Wilt %	粉介殼蟲爲害率 Mealybug Infestation %	萎凋率 Wilt %	粉介殼蟲爲害率 Mealybug Infestation %	萎凋率 Wilt %	粉介殼蟲爲害率 Mealybug Infestation %	萎凋率 Wilt %
43 年 12 月 Dec., 1954	47.92	0	6.25	1.67	58.33	0	87.50	21.11
44 年 3 月 Mar., 1955	52.08	7.22	17.08	2.22	75.00	7.77	95.83	56.67
44 年 5 月 May, 1955	35.42	8.33	41.67	2.22	75.00	13.33	89.58	66.11
44 年 7 月 July, 1955	57.22	8.89	90.56	2.78	92.78	8.89	100.00	63.89
螞蟻密度 (個數/0.25M²) Density of Ants (Ants/0.25M²)	0.60		0.01		2.69		6.44	

(註) 1. 螞蟻密度係每 0.25M² 內之個數，本數字係自43年 3 月至44年 5 月，調查八次之平均數，選樣地點係在本田與保護行間之空地上。
2. 各區粉介殼蟲爲害百分率(%)，係抽樣調查50株之結果，調查時拉開靠近地面之葉片視其內有無粉介殼蟲附着，作爲「爲害」與否，不計蟲數之多寡。

表 4 各區之產量

Table 4. Yield of Each Plot

處理 Treatments	栽植株數 No. of Plants Planted	結實率% % of Fruiting	健全果數 No. of Healthy Fruits	健全果總重量(公斤) Wt. of Healthy Fruits	萎凋果數 No. of Wilted Fruits	萎凋果總重量(公斤) Wt. of Wilted Fruits	每區合計重量(公斤) Wt. of Fruits Per Plot	每公頃產量(公噸/公頃) Yield (M. T./ha)
Dieldrin 0.25%	180	97.78	175	331.6	1	0.5	332.1	46.13
Aldrin 0.25%	180	94,44	158	291.2	12	7.8	299.0	41.53
DDT 0.25%	180	94.44	160	294.4	10	7.5	301.9	41.93
Check	180	61.67	65	120.6	46	26.9	147.5	20.49

對於防治螞蟻，以地特靈爲最優。阿特靈本亦有防蟻特效，此次所用之阿特靈，可能係放置過久之故。

表3對照區內之萎凋病率，有超乎尋常之高。一方面與螞蟻之多少有關，另方面試驗區內之粉介殼蟲，均係來自萎凋株，株株相傳，故萎凋之發生特多[5]。

三、控制螞蟻對於鳳梨粉介殼蟲生態之影響

螞蟻與鳳梨粉介殼蟲之關係，由前述二試驗，可略見端倪。如果螞蟻可以控制，則外界粉介殼蟲之侵入極少，縱或侵入，亦極緩慢，或侵入之機會減少，故可保護本田內之鳳梨，免受萎凋病之爲害。

上述保護行試驗，本田內之螞蟻，未行直接控制，故其與粉介殼蟲之直接關係，尙未十分明瞭，乃作進一步之觀察，以期了解螞蟻對於鳳梨粉介殼蟲之生態之影響。

材料及方法：供試種苗係開英種鳳梨裔芽，係採自一般鳳梨粉介殼蟲爲害之鳳梨園中者，其上附着有數目不等之粉介殼蟲。種植前種苗不做任何處理，種植於連作地上，土地係砂質壤土，適於粉介殼蟲之繁殖。植後將該地劃爲二區，一區爲自然區，植後不加任何處理；一區爲防蟻區，植後每隔兩個月撒佈0.25%阿特靈（Aldrin）一次，阿特靈係撒佈於鳳梨行間之土面上，以防治園中之螞蟻[註]。

植後一月，即開始調查。每月調查二次，每次每區拔取鳳梨20株，詳細記載每株上粉介殼蟲之數目，寄生部位及鳳梨園中之螞蟻密度；並調查萎凋株數，直至鳳梨採收爲止。

試驗結果：鳳梨粉介殼蟲，通常多係附着於種苗上，賴以傳佈至栽培地區。通常種苗上附着之蟲數，並不太多，平均爲3—5個之譜[23]。植後逐漸繁殖，一年後達至高峯，足以引起嚴重之萎凋病(通常5—6個月，粉介殼蟲繁殖之數目及附着爲害之期間，即可引起萎凋病。然在目前栽培制度下，其時恰逢雨季，粉介殼蟲之數目，常因豪雨而減少，而雨季後再度增加，萎凋亦於斯時開始)。但若將鳳梨園中之螞蟻加以防治（阿特靈之防蟻效果尙好，對於粉介殼蟲之防治效力甚低。且撒佈時係噴於行間地上，並非集中於鳳梨植株上），則粉介殼蟲之數目，不但不能增加，反逐漸遞減。表5係自鳳梨定植後至採收期，二十三個月來調查之結果，防蟻區內之螞蟻，始終保持極低之程度，其區內粉介蟲之爲害率及每株平均蟲數，均一一逐漸降低，因之萎凋病之發生亦隨之減少而至滅跡，此點實係由相反方向，重新證明 Carter 博士之毒量分泌原理[3]，對於鳳梨粉介殼蟲萎凋病之關係。自然區內之粉介殼蟲逐月增加，萎凋之發生最高達36.5%。全區內鳳梨植株矮小，抽穗結實率僅爲21.17%（表6），較之防蟻區內鳳梨結實率爲82.68%，判然有別。

表 5　自然區與防蟻區內鳳梨粉介殼蟲及螞蟻密度

Table 5. Density of Mealybugs and Ants in Both Ant-control and Ant-infested Plots

調查日期年月 Date of Survey		自然區 Ant-infested Plot				防蟻區 Ant-control Plot			
		粉介殼爲害率 Mealybug Infestation(%)	每株平均蟲數 No. of Mealybugs per Plant(Av.)	螞蟻密度 Density of Ants (Ants/0.25M²)	萎凋率 Wilt (%)	粉介殼蟲爲害率 Mealybug Infestation (%)	每株平均蟲數 No. of Mealybugs per Plant(Av.)	螞蟻密度 Density of Ants (Ants/0.25M²)	萎凋率 Wilt (%)
44年 1955	10	17.50	1.4	0.85	—	20.00	0.4	1.9	—
	11	17.50	1.8	1.55	—	42.50	5.2	0	—

(註)　臺灣鳳梨園中之螞蟻，據高橋良一氏之記載，有下列三種：

(1) *Pheidologeton diversus* Jerdon

(2) *Anopholepis longipes* Jerdon

(3) *Camponotus friedae* var. *amia* Ferel.

	12	35.50	30.3	1.45	—	35.00	14.9	0	—
45年 1956	1	55.00	61.7	0.65	—	40.00	19.9	0	—
	2	75.00	97.1	1.45	6.48	10.00	1.6	0	2.56
	3	85.00	52.6	0.85	13.23	15.00	22.7	0	2.80
	4	77.50	140.1	3.00	8.21	32.50	13.6	0.90	2.63
	5	92.50	162.4	5.15	3.28	45.00	6.6	0	3.00
	6	92.50	114.3	7.40	1.01	15.00	1.5	0.40	0.84
	7	92.50	132.4	7.50	4.80	10.00	1.3	0	0.88
	8	90.00	195.2	5.65	3.50	0.25	0.1	0.05	0.15
	9	87.50	119.2	12.05	4.16	0	0	0.60	0
	10	90.00	587.8	11.75	15.48	0	0	0.10	0.54
	11	100.00	179.3	6.25	25.62	10.00	0.4	0	1.35
	12	100.00	540.0	1.85	31.72	22.50	1.0	0	0.63
46年 1957	1	100.00	511.2	0.60	31.69	30.00	0.4	0	0.91
	2	100.00	573.6	1.10	33.52	10.00	0.1	0.10	0.25
	3	100.00	360.7	1.35	31.82	40.00	3.6	0	0
	4	100.00	646.5	7.20	32.63	20.00	1.8	0	0
	5	100.00	269.8	4.35	36.50	85.00	181.2	0.10	0
	6	100.00	153.3	8.10	18.40	45.00	107.0	0.25	0
	7	95.00	212.0	3.45	14.89	85.00	123.8	0.20	0
	8	87.50	195.8	4.25	—	75.00	117.9	0.10	—

表 6 自然區與防蟻區內鳳梨結實率

Table 6. Percentage of Fruit setting in Both Ant-control and Ant-infested Plots

處理 Treatments	調查株數 No. of plants Counted	結實株數 No. of plants Fruited	結實率 % of Fruiting
自然區 Ant-infested Plot	1,034	219	21.17
防蟻區 Ant-control Plot	358	296	82.68

阿特靈之效能在防治螞蟻，消除螞蟻訪問粉介殼蟲之活動，並不能防治鳳梨粉介殼蟲。故防蟻區內之粉介殼蟲，仍有存在，僅是數目之減少而已。此種減少，乃係螞蟻絕跡之後果。至於螞蟻缺少，粉介殼蟲不能正常蕃殖之原因何在，尚待進一步之研究。

每次調查時，對於粉介殼蟲之寄生部位，亦曾加以分別（表7,8），以期明瞭粉介殼蟲在鳳梨植株之分佈，及季節的變遷，與粉介殼蟲之移動與螞蟻之關係。

通常鳳梨粉介殼蟲在鳳梨植株上之分佈，約略可分三大部份。即根部(鬚根、纏繞根、塊莖)，葉基部（外層、中層、內層）及果實部（果柄、果實、裔芽、冠芽）。一般情形，90%之粉介殼蟲附着於葉之基部，即土面上下之處，分佈於各層葉片夾縫之間。10%分佈於根部。鳳梨結果後，約有半數之粉介殼蟲在果實上（見表7）。根部蟲數較少，並未隨氣候雨量而變化。粉介殼蟲原均附着於種苗之基部，故於初種後4—5個月內，仍分佈於地下部，較之其他時間，根部之蟲數略高。防蟻之後，根部蟲數分佈比率，略形增加，但亦僅係種植後8—9月內之情形，八、九個月之後，根部蟲

數比率大減，鳳梨結果後，90%以上之粉介殼蟲，發現於果實部。此等粉介殼蟲均係幼蟲(Crawlers)活動性較大，約略平均分佈於果實，裔芽及冠芽上 (表 8)。

表 7 自然區粉介殼蟲在鳳梨上棲息分佈(百分率)

Table 7. Distribution of Mealybugs in Percentage in Pineapple Plant from Ant-infested Plot

調查年月 Date of Survey		根部 Roots and stem underground				葉基部 Leaf base aboveground				果實部 Fruits				
		鬚根 Lateral Roots	纏繞根 Roots tangled to stem	塊莖 Stem	合計 Total	外層 Outer layers	中層 Medium layers	內層 Inner layers	合計 Total	果柄 Stalks	果實 Fruits	裔芽 Slips	冠芽 Crowns	合計 Total
44年 1955	10	10.27	6.94	17.34	24.55	6.20	20.72	48.53	75.45					
	11	17.86	0	12.86	30.72	2.85	54.32	12.11	69.28					
	12	10.09	3.70	8.89	22.68	12.67	44.22	20.43	77.32					
45年 1956	1	6.47	4.28	2.77	13.52	5.99	57.01	23.48	86.48					
	2	7.33	8.16	9.84	25.32	16.19	44.17	14.32	74.68					
	3	4.23	9.56	0	13.79	15.28	50.53	20.40	86.21					
	4	2.04	2.95	1.57	6.56	28.00	44.65	20.80	93.44					
	5	5.82	4.35	2.14	12.31	23.70	51.24	12.75	87.69					
	6	1.29	4.00	0.35	5.64	32.81	50.60	10.95	94.36					
	7	0.48	1.68	0.57	2.73	27.85	50.36	19.06	97.27					
	8	1.45	1.71	0.46	3.62	13.80	67.89	14.69	96.38					
	9	1.33	0.75	0.01	2.10	6.04	72.23	19.64	97.90					
	10	1.64	0.68	0.40	2.72	23.38	70.68	8.22	97.28					
	11	1.68	1.48	0.36	3.52	8.17	67.97	20.34	96.48					
	12	1.00	1.14	0.83	2.97	15.77	59.24	22.02	97.03					
46年 1957	1	2.18	0.71	1.11	4.00	11.08	60.30	24.62	96.00					
	2	1.89	2.01	1.12	5.02	19.83	38.09	37.06	94.98					
	3	2.21	1.33	0.69	4.23	16.90	37.45	40.75	95.10	0.62	0.05	0	0	0.67
	4	0.76	2.47	0.19	3.42	34.85	27.82	21.22	83.89	9.00	1.47	2.22	0	12.69
	5	1.10	3.00	0.42	4.52	11.41	11.01	2.13	24.55	14.84	13.00	27.74	15.35	70.93
	6	1.83	3.14	1.15	6.12	22.95	10.53	6.10	39.58	15.13	9.16	18.66	11.35	54.30
	7	0.50	3.61	0 52	4.63	13.75	12.56	15.00	41.31	11.48	7.68	23.03	11.87	54.06
	8	2.20	3.12	0.71	6.03	7.34	16.44	22.37	46.15	5.22	3.66	22.43	16.50	47.82
結果前平均 Infestation before Fruiting		10.69				89.31								
結果後平均 Infestation after Fruiting		4.82				55.10				40.08				

表 8 防蟻區粉介殼蟲在鳳梨上棲息分佈(百分率)

Table 8. Distribution of Mealybugs in Percentage in Pineapple Plant from Ant-control Plot

調查年月 Date of Survey	根部 Root and Stem underground				葉基部 Leaf base aboveground				果實部 Fruits				
	鬚根 Lateral Roots	纏繞根 Roots tangled to stem	塊莖 Stem	合計 Total	外層 Outer layers	中層 Medium layers	內層 Inner layers	合計 Total	果柄 Stalks	果實 Fruits	裔芽 Slips	冠芽 Crowns	合計 Total
44年 1955 10	12.07	13.80	6.89	32.76	2.94	47.36	16.94	67.24					
11	11.54	5.05	0.48	17.07	19.18	42.11	21.64	82.93					
12	0.25	36.47	9.65	46.37	7.68	32.98	12.97	53.63					
45年 1956 1	0.34	6.34	7.00	13.67	27.94	50.90	7.49	86.33					
2	0	5.58	1.21	6.79	19.93	54.64	18.64	93.21					
3	0	10.17	1.21	11.38	25.35	52.73	10.54	88.62					
4	0.85	20.10	3.21	24.16	28.15	28.32	19.37	75.84					
5	0	18.33	2.78	21.11	33.85	35.23	9.81	78.89					
6	23.85	11.54	0	35.39	39.73	18.86	6.02	64.61					
7	0	0	0	0	0.94	57.78	41.28	100.00					
8	0	0	0	0	0	0	100.00	100.00					
9	0	0	0	0	0	0	0	0					
10	0	28.57	0	28.57	0	71.43	0	71.43					
11	35.30	0	0	35.30	4.84	44.59	15.27	64.70					
12	15.00	0	0	15.00	17.89	49.41	17.70	85.00					
46年 1957 1	0	0	0	0	19.41	67.08	13.51	100.00					
2	0	0.41	0.17	0.58	5.14	34.48	59.80	99.42					
3	0	0	0	0	13.89	17.21	68.90	100.00					
4	0	0	0	0	14.71	19.07	10.53	44.31	9.73	23.83	20.70	1.43	55.69
5	0	0.05	0	0.05	0.28	0.49	0.26	1.03	24.06	17.72	38.34	18.80	98.92
6	0	0.64	0	0.64	0.11	0.03	5.80	5.94	5.80	7.37	31.11	54.94	99.22
7	0	0.53	0	0.53	0.18	0.12	0.17	0.47	7.55	4.25	48.22	44.98	99.00
8	0	0	0	0	0	0.59	0.02	0.61	9.30	16.68	45.72	27.69	99.39
結果前平均 Infestation of Mealybug before Fruiting	16.48				83.52								
結果後平均 Infestation of Mealybug after Fruiting	0.24				9.31				90.45				

四、螞蟻活動調查及防除試驗

螞蟻與鳳梨粉介殼蟲生態之關係既如上述，則防治鳳梨粉介殼蟲除應用有機燐類殺蟲劑外[21]螞蟻之活動及其防治，對於鳳梨萎凋病之預防，亦甚重要。茲將對螞蟻之活動觀察及一二防治測驗，摘要如次。

1. 螞蟻周年活動調查：下列調查(表 9)係二年來連續觀察鳳梨園中各種螞蟻活動之結果。調

查時，以鐵線作成0.25平方公尺之方框，隨機取樣，調查方框內螞蟻之數目。每月調查二次，每次調查四十處。由表9可知氣溫對於螞蟻之活動，有密切之關係。冬季寒冷時，地面上螞蟻減少，夏季高溫時增多。冬季中午較朝夕活動多，夏季中午較朝夕活動爲少。小雨對螞蟻之活動無影響。

表 9 鳳梨園中螞蟻之密度表

Table 9. Density of Ants in Pineapple Orchard

年次 Year	每月螞蟻密度 (個數/0.25M²) Density of Ants (Ants/0.25M²)											
	1	2	3	4	5	6	7	8	9	10	11	12
43 年	1.4	1.0	3.3	5.3	4.7	4.6	8.3	7.5	10.3	12.8	11.6	6.5
45 年	1.0	1.0	1.5	3.3	3.7	7.2	6.5	7.5	11.3	9.2	7.4	3.3
平 均	1.2	1.0	2.4	4.3	4.2	5.9	7.4	7.5	10.8	11.0	9.5	4.9

2. 螞蟻之防治：測驗一、應用藥劑爲阿特靈 (Aldrin) 乳劑，地特靈 (Dieldrin) 乳劑，及 DDT 乳劑。濃度均爲 0.25%，每平方公尺內施用藥液 200cc。藥劑撒佈後，每隔十日調查地面上之螞蟻密度。結果如表10。

表10 Aldrin, Dieldrin, DDT 對螞蟻之防治效果

Table 10. Activity of Ants After the Treatments with Aldrin, Dieldrin, and DDT Emulsions

處理 Treatments	螞蟻密度 (個數/0.25M²) Densily of Ants (Ants/0.25M²)					
	10 日 days	20 日 days	30 日 days	40 日 days	50 日 days	60 日 days
0.25% Aldrin	0.08	0.39	0.25	0.78	1.20	0.92
0.25% Dieldrin	0	0	0	0.01	0.06	0
0.25% DDT	0.88	1.93	2.64	3.29	3.74	2.65
Check	6.14	5.64	6.94	5.46	6.96	7.50

(註) 上表數字係調查八處之平均數

測驗二、應用藥劑有：23% Aldrin 乳劑，15% Dieldrin 乳劑，及靈丹 (Lindane) 粉劑。爲一般應用方便計，Aldrin 之濃度爲400倍，Dieldrin 之濃度爲200倍，施用藥量爲每平方公尺內撒佈 200cc，靈丹粉劑以每公頃20公斤之用量施用。調查方法同前。

表 11 Dieldrin, Aldrin, Lindane 之防蟻效果表

Table 11. Activity of Ants on Ground After the Treatments with Dieldrin, Aldrin, and Lindane

處理 Treatments	螞蟻密度 (個數/0.25M²) Density of Ants after (Ants/0.25M²)					
	10日 days	20日 days	30日 days	40日 days	50日 days	60日 days
15% Dieldrin 1-200	0	0	0.11	0.03	0.21	0.34
23% Aldrin 1-400	0.43	0.78	2.56	2.15	3.74	4.38
Lindane 20kg/ha.	2.40	4.08	5.29	6.93	9.52	10.03
Check	13.87	14.23	10.58	16.10	19.43	16.75

由上述二次初步測驗，可知地特靈 (Dieldrin) 對螞蟻之防治效果極優，而且持久，阿特靈 (Aldrin) 次之，但如濃度高時，亦可維持藥效甚久。

五、討　　論

螞蟻與粉介殼蟲之經常共處現象，爲一習見之事實。有關二者之關係，一般論者均加以强調，但常乏有力證據。本文之保護行試驗，係針對防治螞蟻，以阻止鳳梨粉介殼蟲侵入新園，其效果甚爲顯著。此種效果，一方面顯示螞蟻之減少，粉介殼蟲失缺有力之傳佈媒介；同時，因螞蟻之減少，粉介殼蟲本身之數目，不能增加，減低向外傳佈之機率。

當螞蟻被控制後，鳳梨粉介殼蟲之數目，亦隨之逐漸降低；其結果，萎凋病幾至絕跡。此點重新證明 Carter 博士之鳳梨粉介殼蟲毒量分泌原理[3]及鳳梨粉介殼蟲萎凋之 Mass Action 現象[2]。在防治粉介殼蟲萎凋病方面，具有重大意義。鳳梨粉介殼蟲，通常寄生於靠近地面之鳳梨葉片間及地下之塊莖及根部。因之藥劑之防除，極難達至完全防治之目的。目前藥劑防治之目的，亦係壓低粉介殼蟲之數目，使之不能到達引起萎凋之程度。此等效力，防蟻措施亦可達到。實異曲同功。惟經濟之觀點，尙待考慮。或粉介殼蟲之防治與防蟻相輔並用，以期獲得更佳之效果，此乃今後研究萎凋病防治之另一路線。

Le Polley[11]謂咖啡園中之螞蟻防治後，粉介殼蟲均被天敵消滅。DeBach[20]謂若欲以天敵控制柑桔介殼蟲類之發生，必須先防治螞蟻。其他謂螞蟻保護粉介殼蟲，免受瓢蟲之吃食[9,12]。螞蟻清掃粉介殼蟲分泌之蜜露，免受黴菌之寄生。凡此種種，在本調査內均未有重要之佐證。何者爲控制粉介殼蟲繁殖之重要因素，尙待今後之研究。筆者深信粉介殼蟲之蜜露，可引誘螞蟻，減少黴菌之寄生，較有重大意義。

鳳梨粉介殼蟲，通常均在葉之基部。抽穗結實後喜上移至果實上。粉介殼蟲一旦移至多汁之果實及幼嫩之芽體上後，其繁殖力倍加。鳳山熱帶園藝試驗所在研究鳳梨及香蕉之粉介殼蟲時，亦有此種發現[24,25]。即無論鳳梨上之粉介殼蟲或香蕉上之粉介殼蟲，在香蕉果實上飼養，其生活史縮短，其繁殖力不但迅速，而且數量亦多。反之將二者移於鳳梨葉片上，其生活史延長，繁殖亦慢，數量亦少。與田間之情形相同。此種現象，對於萎凋病之發生及防治，均有益而無害。蓋粉介殼蟲之爲害鳳梨，引起萎凋之重要部位在葉片基部之白嫩部份[15]，故粉介殼蟲於結果期上移，可減少萎凋 (表 5)。且採果，採苗，可使大部份粉介殼蟲離開鳳梨園，再經加工，浸苗等操作，將粉介殼蟲消滅，對於防治上及粉介殼蟲之蔓延均有重大意義。

Platt[8] 謂乾季中螞蟻將粉介殼蟲帶至地下，濕季則將其帶至果實上，此點在本調査中未得證實。粉介殼蟲之上移，主要在食料之關係。

於前述各試驗中，最使吾人困惑者，乃是萎凋發生之起伏不定 (表1, 2, 5)。此爲鳳梨萎凋病之複雜性，一方面與粉介殼蟲本身之毒性，植株之抵抗性有關[1]，另方面與一地之氣候亦有密切關係。臺灣中南部之氣候有兩個極端：每年十月至次年四月爲乾季，適於粉介殼蟲之蕃殖；四、五月開始至九月爲雨季，常有連綿濠雨，不適於粉介殼蟲之蕃殖。表 5 自然區內萎凋率，常隨季節而有起伏。此與臺灣各地一般鳳梨萎凋病之發生方式相同，即種植後半年，萎凋病開始發生。此時正値2—3月間，氣候乾燥，溫度亦開始上昇，正適於粉介殼蟲之蕃殖，萎凋病遂有逐日增加之勢，但不久 4—5 月雨季來臨，粉介殼蟲又因之減少，雨水使鳳梨生長迅速而旺盛，故萎凋病隨之降低。至十月雨季結束，粉介殼蟲蕃殖驟增，萎凋病再度增加，在此乾燥期(十月至翌年三、四月)，萎凋病逐漸達至高峯，至結果後，粉介殼蟲移至果實上，亦因雨季來臨，蟲數減少，萎凋又降低。此種鳳梨萎凋病發生之韻律，常使人誤爲萎凋病乃係乾旱所致。

基於上述原因之萎凋病率之起伏，乃是病株恢復之關係。粉介殼蟲所分泌之毒汁，不同於過濾性毒素 (Virus)[4]。當粉介殼蟲數目減少或消失之後，則毒汁亦逐漸消散，病株即行恢復。鳳梨自定植後，至翌年六月以前所發生之萎凋株，其恢復百分率較高 (表12)。七月以後發生者，幾乎不

能恢復，或需較長時間之恢復。故萎凋病於此階段（定植後之翌年九月至抽穗（2—3月）），關係最爲重要。吾人所用之防蟲及防蟻等法，均在降低生育初期粉介殼蟲之數量，以防此階段萎凋病之發生也。

表 12 鳳梨萎凋發生時期與恢復之關係

Table 12. The Occurrence and Recovery of Pineapple Mealybug Wilt Disease

萎凋病發生月別 Month that wilt appeared	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月
萎凋株數 No. of plants wilted	223	27	9	21	16	33	70	117	109	138
恢復株數 No. of plants recovered	219	23	7	7	0	0	0	0	0	0
恢復百分率 Recovery (%)	98.21	85.19	77.77	33.33	0	0	0	0	0	0
恢復株出穗株數 No. of plants fruited from recovered plants	74	8	4	3	0	0	0	0	0	0
出穗率 (%)of Fruiting	33.79	34.78	57.14	42.86	0	0	0	0	0	0

六、提　　要

一、鳳梨粉介殼蟲所引起之萎凋病，臺灣各地均極普遍，因其寄生部位之隱蔽，甚難達到完全防治之地步；加之鳳梨係長期作物，粉介殼蟲往往由殘餘之少數，逐漸繁殖至數百，足以引起萎凋，乃防治上之重大困難，亦爲本文研究粉介殼蟲與螞蟻之關係之目的。

二、栽培鳳梨時，於田地之四周，種植四行至六行之鳳梨，作爲保護行，於保護行上，撒佈防蟻藥劑，防治其上之螞蟻，可以間接阻止鳳梨粉介殼蟲之傳入，對於預防本田內萎凋病之發生，其效果甚優。

三、如果鳳梨園中之螞蟻可以控制，使其滅跡或減至極少，則鳳梨上之粉介殼蟲，數目逐漸減少，其萎凋病率逐漸降低，而至於完全無萎凋，獲得較高之結實率。較之未防蟻區，粉介殼蟲數及萎凋病逐日增加，結實率甚低，二者結果，極爲顯著。

四、鳳梨結實以前，粉介殼蟲並未因氣候雨量之變化，而有上下遷移之現象。惟抽穗結實後，粉介殼蟲喜移至果實，冠芽，及裔芽上。

五、粉介殼蟲一旦移至幼嫩之果實及芽體上，其繁殖力培增，可在極短時間內，生出多數幼蟲，於防蟻區內，尤爲顯著。此等幼蟲，其活動力較大。惟此等粉介殼蟲，可於採果採苗時，脫離母株，對於防治上有益無害。

六、鳳梨園中之螞蟻，周年均有活動。惟受氣蟻溫之影響頗大，低溫時螞蟻數少，高溫時多。

七、防蟻劑藥以地特靈 (Dieldrin) 爲最優，而且持久，阿特靈 (Aldrin) 次之。DDT, BHC 之效果較差。

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STUDIES ON THE RELATIONSHIP OF ANTS WITH MEALYBUG WILT OF PINEAPPLES

by

SHOU-KUNG SUN

SUMMARY

The present paper deals with the relationship of ants with pineapple mealybugs and their influence to pineapple wilt, a disease which is ensued from the infestation of pineapple mealybug (*Dysmicoccus brevipes* Ckl.)

Ants are frequent attendants of mealybugs in pineapple orchards. They are probably carriers of mealybugs from wild vegetations or adjacent pineapple orchards to new plantations. This assumption has been proved to be true to a certain extent from the guard row planting experiments, in which ant-killer insecticides were sprayed on the ground of the guard rows. Mealybug infestation and wilt in the main plantation were greatly reduced by these treatments.

If ants are effectively controlled in pineapple field, mealybugs will suffer an extraordinary change in their lives. Multiplication is naturally suppressed, colonies and population are gradually reduced to a ninimum, though not extinguished. The result is: wilt disappears and yield increases. This fact is considered to be very important in our practising of mealybug and wilt control. For insecticides so effective as parathion, etc., can not even kill the mealybugs completely as pineapple mealybugs are commonly hidden so low between the bases of leaf blades and on roots close to the plant. The application of organo-phosphorus insecticides is simply to suppress the population of mealybugs to such a degree as they are unable to induce wilt. This purpose can also be obtained by the controlling of ants. These two different methods of suppressing the population of mealybugs can be used alternatively and need further evaluation in our future studies of mealybug wilt control of pineapples.

There is no evident upward and downward migration of the pineapple mealybugs on pineapple plant, before the period of the fruits being sent out, due to the changes of temperature and precipitation. After fruiting, mealybugs have a tendancy to migrate upward to the fruits, crowns, and slips. Soon as the mealybugs reach these tender and succulent parts, they multiply tremendously. Numerous crawlers are produced within a short period. These mealybugs, however, can be detached from the mother plants through harvesting and collecting of the planting materials.

Ants can be found in pineapple orchards all year round in South Taiwan, but their activity is closely influenced by the atmospheric temperature. Low temperature greatly limits the activity of the ants.

Dieldrin was found to be the most effective insecticide for ant control in the author's preliminary tests.

施藥時期及次數之不同對棉金鋼鑽蟲防治效果試驗

陶 家 驊　 眭 國 彥

一、前　　言

棉金鋼鑽 (Earias fabia Stoll) 爲本省主要棉鈴害蟲之一，對本省植棉事業之成敗，影響匪淺。筆者等曾於民國42年及43年採用有機磷和氯化烴類殺蟲劑舉行田間防治，成效卓著，每公頃籽棉產量達 2,663～2,956公斤。其中以 0.05% Endrin 乳劑及 0.25% Dieldrin 水懸性粉劑最優，惟因此類殺蟲劑，均賴國外輸入，棉農負擔，尙嫌太重。乃採用上項兩種殺蟲劑在嘉義舉行施藥時期及次數之比較試驗，藉期減輕費用而利大規模推廣，爰將本試驗結果，草爲斯文，謹就正於同道。

二、試 驗 方 法

本試驗係於民國44年在省立嘉義高級示範農業職業學校農場舉行，供試驗品種爲 Delfos 關東119號，小區面積爲 $50m^2$，5行每行20株，全區定植共 100 株，行株距 1m×0.5m，於7月4日播種，曾補種2次，方法爲點播，藥劑處理9種，並分爲不同施藥時期和次數3種，隨機排列，重複4次，另設對照區以資比較。施藥6次者每14天施藥1次，自8月6日～10月17日；施藥5次者每10天施藥1次，自9月5日～10月15日；施藥4次者每7天施藥1次，自9月5日～9月26日。每次施藥之稀釋倍數及用量標準，按棉株生育情形而決定。19.5% Endrin 乳劑稀擺 1:780 倍，50% Dieldrin 水懸性粉劑 1:400 倍，25% DDT 乳劑 1:400 倍，施藥6次者所需原藥之 Endrin 乳劑 9.46 公升，Dieldrin 水懸性粉劑 17.5 公斤，DDT 乳劑 17.5 公升，5次者所需 Endrin 乳劑 9.05 公升，Dieldrin 水懸性粉劑 16.75 公斤，DDT 乳劑 16.75 公升，4次者所需 Endrin 乳劑 7.02 公升，Dieldrin 水懸性粉劑13公斤，DDT 乳劑 13公升。各次施藥稀釋倍數一律，其每次稀釋液一公頃用量標準列表如下：

表1　每次稀釋液施用量　(公升/公頃)

Table 1. The amount of applications of insecticidal solution on each time per hectare.

施藥次數 No. of applications	第1次 1st	第2次 2nd	第3次 3rd	第4次 4th	第5次 5th	第6次 6th	合計 Total
6	800	1,000	1,000	1,200	1,500	1,500	7,000
5	1,000	1,200	1,500	1,500	1,500	—	6,700
4	1,000	1,200	1,500	1,500	—	—	5,200

三、試 驗 結 果

（1） 落蕾和落鈴之蟲害率：花蕾及幼鈴之脫落，除氣候和生理2項外，蟲害亦爲重要因素之一。今年氣候特殊，落鈴及落蕾時期較往年晚月餘，9月杪始發現地上落蕾及落鈴。調查工作自9月29日起至11月29日日止，間隔7天舉行1次，先後共9次，每次檢拾各小區地上所有落蕾及落鈴，分盛紙袋中，携回室內分別檢查。經分析結果，得知落蕾及落鈴之差異，在早期及晚期各處理，概

不顯著，惟中期處理之差異，稍爲顯著，詳見表 2.

表 2　施藥不同時期與藥劑間對落蕾鈴類和蟲害消長關係之調查　(%)

Table 2. Investigations on the infestations of both shedding squares and bolls between the insecticides and numbers of applications (%)

(A)

藥　劑 Chemicals	施藥次數 No. of Applications	29/Ⅸ	4/Ⅹ	11/Ⅹ	18/Ⅹ*	26/Ⅹ	2/Ⅹ	10/Ⅺ	17/Ⅺ*	24/Ⅺ	平　均 Average
Endrin 乳　劑	6	29.17 (25.28)	59.79 (50.66)	32.40 (30.74)	26.78 (30.93)	21.19 (26.95)	38.91 (38.20)	58.88 (50.30)	79.74 (64.75)	100.0 (90.00)	49.65 (45.31)
	5	37.50 (33.75)	30.39 (25.61)	49.49 (48.09)	22.40 (28.14)	35.24 (36.37)	58.75 (50.42)	75.77 (61.01)	85.16 (71.99)	99.12 (88.24)	54.92 (49.29)
	4	50.00 (45.00)	37.75 (27.69)	30.49 (32.71)	43.60 (41.32)	48.44 (44.11)	48.43 (44.08)	73.14 (62.91)	96.00 (80.15)	98.22 (84.59)	58.01 (51.40)
Endrin+DDT 乳　劑	6	0 (0)	23.81 (21.77)	16.63 (21.03)	20.43 (26.77)	21.64 (27.43)	24.63 (29.39)	67.66 (55.92)	91.70 (75.59)	97.49 (87.97)	40.67 (38.43)
	5	20.84 (19.72)	23.74 (24.90)	5.56 (7.03)	16.06 (23.03)	28.09 (30.89)	41.78 (40.17)	68.11 (59.73)	11.29 (75.46)	95.02 (81.02)	43.39 (40.22)
	4	0 (0)	0 (0)	26.35 (26.28)	37.75 (37.89)	48.13 (43.94)	50.08 (45.01)	68.75 (57.40)	90.18 (74.76)	99.59 (88.18)	46.79 (41.50)
Dieldrin+DDT 水懸性粉劑十乳劑	6	35.42 (28.69)	38.45 (34.26)	17.81 (17.94)	24.82 (29.34)	15.53 22.90	13.89 (18.71)	40.42 39.22	89.32 (77.06)	100.0 (90.00)	41.74 (39.79)
	5	25.00 (22.50)	38.35 (37.42)	30.11 (28.95)	26.44 (30.91)	31.77 (34.21)	49.12 (44.47)	72.60 (62.36)	96.62 (82.96)	99.82 (88.59)	52.19 (48.01)
	4	8.33 (8.87)	34.17 (35.17)	47.32 (43.39)	42.55 (40.73)	35.61 (36.63)	54.15 (47.49)	80.47 (67.13)	94.28 (78.21)	100.0 (90.00)	55.21 (49.72)
對照區 Check		29.17 (24.94)	44.17 (37.69)	28.33 (28.33)	46.28 (42.86)	49.83 (45.04)	69.86 (57.30)	46.06 (39.27)	89.05 (70.91)	87.50 (78.75)	54.47 (47.23)
最小差異顯著平準 (L.S.D.)	5	41.14	30.08	30.77	8.65	10.08	13.51	16.50	11.61	11.46	
	1	55.56	40.62	41.55	11.86	13.61	18.24	22.28	15.68	15.48	

註：括弧內係百分率化爲轉角函數，再以分析，測定差異顯著性。
* 係施藥區與對照區之差異顯著性。
(A) 落蕾和蟲害關係之調查。

(B)

藥　劑 Chemicals	施藥次數 No. of Applications	29/Ⅸ	4/Ⅹ	11/Ⅹ	18/Ⅹ*	26/Ⅹ*	2/Ⅺ*	10/Ⅺ*	17/Ⅺ	24/Ⅺ	平　均 Average
Endrin 乳　劑	6	33.33 (31.31)	23.82 (21.22)	8.52 (14.46)	5.16 (13.12)	9.42 (17.28)	13.56 (20.78)	32.48 (34.66)	59.61 (50.75)	77.65 (61.79)	29.26 (29.49)
	5	0 (0)	3.57 (5.56)	12.05 (20.02)	6.60 (14.78)	19.32 (25.43)	13.83 (21.74)	35.34 (36.22)	76.19 (61.50)	88.52 (70.59)	28.38 (28.43)
	4	0 (0)	0 (0)	27.26 (31.23)	14.87 (22.61)	24.86 (29.13)	17.27 (24.35)	33.18 (34.71)	68.29 (56.62)	85.39 (67.67)	30.12 (29.59)
Endrin+DDT 乳　劑	6	0 (0)	12.56 (17.34)	10.53 (15.90)	7.65 (14.98)	8.20 (16.33)	6.85 (15.50)	34.84 (35.72)	69.00 (55.36)	79.36 (64.02)	25.44 (26.24)
	5	0 (0)	3.85 (5.78)	12.90 (19.35)	7.26 (15.21)	11.51 (19.66)	12.28 (20.21)	34.91 (36.15)	66.14 (56.07)	83.92 (66.61)	25.86 (25.56)
	4	0 (0)	0 (0)	14.68 (19.23)	9.74 (17.80)	17.49 (24.41)	13.97 (21.91)	39.97 (39.12)	74.85 (62.42)	83.06 (66.09)	28.19 (27.89)

Dieldrin + DDT 水懸性粉劑十乳劑	6	0 (0)	13.02 15.24	17.45 (23.53)	6.91 (15.06)	8.24 (16.01)	5.23 (13.15)	27.87 (31.29)	60.40 (51.46)	82.13 (65.75)	24.03 (25.72)
	5	0 (0)	0 (0)	3.41 (9.00)	3.46 (10.70)	14.73 (21.74)	11.01 (19.02)	35.86 (36.56)	68.40 (56.64)	83.06 (67.03)	26.44 (24.52)
	4	25.00 (22.50)	0 (0)	22.02 (27.15)	16.48 (23.64)	21.67 (27.48)	14.53 (22.40)	38.65 (37.61)	75.73 (61.60)	89.36 (72.35)	33.71 (32.75)
對照區 Check		12.50 (11.25)	12.78 (18.15)	20.19 (26.12)	20.49 (26.59)	19.56 (25.46)	18.33 (25.17)	30.00 (32.85)	48.80 (43.94)	70.52 (58.95)	28.13 (29.83)
最小差異顯著平準	5	24.96	22.08	14.40	5.19	9.36	5.26	8.57	10.47	9.57	
(L.S.D.)	1	33.70	29.82	19.44	7.01	12.65	7.10	11.57	14.14	12.92	

註：括弧內係百分率化爲轉角函數再以分析，測定差異顯著性。

* 施藥次數與對照區之差異顯著性。

(B) 落鈴和蟲害關係之調查。

(2) 棉鈴之蟲害率：棉株生長期中，可能遭金剛鑽蟲 4 ～ 5 個世代蹂躪，初則出土後3～4星期之幼苗梢被害，繼則花蕾，幼鈴及鮮鈴。惟因此蟲之密度係屬累積性，愈至晚期，爲害愈烈，調查工作在44年10月 4 日至45月 1 月 5 日間，每隔 2 星期擧行 2 次；先後共 7 次，每次每小區調查20株。據統計結果，在 9月 、10及11月(上旬)，鮮鈴被害率祇2.33～16.56迨至11月下旬驟增達24.98～47.50 %；可見此蟲之本年猖獗時期，較往年延遲月餘，似因 9. 10 月間氣溫突然降下所致。各處理中棉鈴被害率之差異除10月 4 ～ 6 日及12月 6 ～ 8 日兩次外，均不顯著詳見表 3.

表 3 施藥不同時期與藥劑間對棉金鋼鑽蟲爲害時期之調查 (%)

Table 3. Investigations on the infestations of bolls between the insecticides and numbers of applications (%)

藥劑 Chemicals	施藥次數 No. of Applications	4-6/X*	22-24/X	4-8/XI	25-28/XI	6-8/XII*	22-24/XII	5/I	合計 Total	平均 Average
Endrin 乳劑	6	4.07 (11.13)	2.84 (9.45)	2.38 (7.45)	28.98 (31.88)	33.69 (35.47)	41.78 (40.25)	68.70 (59.95)	182.44 (195.58)	26.06 (27.94)
	5	1.68 (5.96)	1.02 (5.50)	4.20 (10.81)	37.84 (37.67)	40.38 (39.33)	49.41 (44.52)	60.92 (56.80)	195.45 (200.59)	27.92 (28.66)
	4	0.12 (0.99)	3.94 (11.42)	3.77 (10.77)	39.47 (38.85)	35.51 (36.58)	55.69 (47.14)	60.79 (50.28)	199.29 (196.03)	28.47 (28.00)
Endrin + DDT 乳劑	6	0.63 (3.62)	2.50 (8.77)	2.64 (7.93)	34.23 (33.30)	31.32 (34.00)	44.66 (41.86)	57.66 (49.70)	173.64 (179.18)	24.81 (25.60)
	5	1.93 (6.80)	2.15 (7.95)	4.13 (10.26)	32.28 (34.55)	35.83 (36.61)	41.92 (43.32)	66.73 (60.20)	185.97 (199.69)	26.42 (28.53)
	4	1.77 (5.12)	1.59 (6.34)	6.02 (13.05)	39.17 (38.44)	34.95 (36.01)	50.53 (45.34)	65.43 (54.53)	209.46 (198.83)	29.92 (28.40)
Dieldrin + DDT 水懸性粉劑十乳劑	6	0.77 (4.22)	0.98 (3.72)	2.44 (7.14)	24.98 (29.93)	29.72 (32.88)	45.03 (39.51)	58.05 (50.99)	161.96 (168.39)	23.14 (24.06)
	5	0.35 (2.38)	2.46 (6.00)	6.13 (11.19)	42.57 (40.68)	34.13 (35.54)	50.66 (45.34)	26.12 (26.45)	162.42 (167.58)	23.20 (23.94)
	4	0.74 (2.52)	2.33 (8.67)	1.75 (7.18)	35.81 (36.59)	37.80 (37.78)	52.30 (46.32)	79.03 (66.68)	209.76 (205.74)	29.97 (29.39)
對照區 Check		4.31 (11.71)	3.34 (9.06)	16.56 21.09	44.75 (41.92)	52.98 (46.92)	62.55 (52.25)	62.96 (52.89)	247.46 (235.84)	35.35 (33.69)

最小差異顯著平準	5	3.80	5.66	11.09	9.01	6.98	7.60	28.87		
(L.S.D.)	1	5.13	7.65	14.98	12.17	9.43	10.26	38.96		

註：括弧內係百分率化爲轉角函數，再以分析，測定差異顯著性。
* 施藥區與對照區之差異顯著。

（3） 每株結鈴數：45年1月5日調查各小區20株上所有鈴數，經分析結果，施藥次數間及藥劑種類間之差異，均屬不顯著，但與對照區之差異，概屬顯著。內以 Endrin 乳劑及 Dieldrin 水懸性粉劑＋DDT 乳劑，施藥6次之兩區爲數最多，平均每株結鈴 31.56～31.25 枚，對照區僅15.00枚。參閱表 4.

（4） 棉鈴吐絮率：通常棉鈴被害後，蛀孔極易發生紅腐病，可使整個棉鈴因先行腐敗而不能吐絮，惟今年氣候特殊，被蛀之棉鈴，鮮有罹紅腐病者，吐絮率竟達 92.91～97.89％；據45年1月5日調查結果，施藥區與對照區間棉鈴吐絮率之差異，均不顯著，參閱表 4.

（5） 籽棉產量：施藥區與對照區間籽棉產量之差異，均屬顯著，且施藥次數間之差異亦屬顯著，各施藥劑處理區之產量指數爲 225.26～289.03。詳見表 4.

表 4 施藥不同時期與藥劑間防治棉金鋼鑽蟲試驗成果

Table 4. Effectiveness of both the insecticides and numbers of applications against spiny bollworm.

藥劑 Chemicals	施藥次數 No. of applications	每株結鈴數平均 No of bolls per plant (AV)	棉鈴吐絮率(%) Percentage of dehiscent bolls	每公頃籽棉產量 (kg) Yield of seed cotton kg/ha.	指數 Index
Endrin 乳劑	6	31.29	97.23	2,792.00	289.03
	5	29.00	96.41	2,760.00	244.31
	4	28.80	95.22	2,294.00	238.51
Endrin＋DDT 乳劑	6	29.35	96.96	2,520.00	260.58
	5	29.15	96.18	2,329.00	240.58
	4	28.89	92.91	2,274.00	235.40
Dieldrin＋DDT 水懸性粉劑＋乳劑	6	31.56	97.01	2,656.00	274.95
	5	31.28	96.92	2,624.00	271.62
	4	27.31	96.12	2,176.00	225.26
對照區 Check		15.00	96.98	966.00	100.00
最小差異顯著平準 (L.S.D.)	5	4.91	5.08	409.40	
	1	6.63	6.87	560.80	

四、結論和提要

本試驗於民國44年在嘉義農校農場舉行，供試驗殺蟲劑爲 Endrin 乳劑，Dieldrin 水懸性粉劑和 DDT 乳劑三種，藥劑處理即 Endrin, Endrin＋DDT, Dieldrin＋DDT，並分施藥 6, 5, 4 次者處理共九個，另設對照區3個，以資比較，藥劑防治棉金剛鑽所受影響之事項如次。

（1） 落蕾和落鈴之蟲害率：施藥區與對照區間之差異，前後兩期不顯著，中期較顯著，但施藥次數間之差異不顯著。

（2） 棉鈴之蟲害率：施藥區與對照區間之差異，早中兩期較顯著，晚期則不顯著，愈至後期

受害率愈高，施藥區之棉鈴受害率平均為 23.20～29.97 %，對照區平均為 35.35%。

（3） 每株棉鈴數：施藥區與對照區之差異，均極顯著，惟施藥之次數間概不顯著，施藥區每株結鈴數平均為 27.31～31.55 枚。對照區15枚幾成 2 與 1 之比。

（4） 棉鈴吐絮率：今年因受氣候特殊，紅腐病鮮有發生，吐絮率竟達 92.91～97.78 %，故施藥區與對照區之差異，概不顯著。

（5） 籽棉產量：施藥區與對照區之產量差異，均屬顯著，惟施藥區間之差異除 4 次外，均不顯著，施藥區每公頃折合籽棉產量達 2176.00～2792.00 公斤，其中以施藥 6 次及 5 次者兩區間最高，其產量指數為 244.31～289.03，施藥 4 次區之產量指數為 225.26～238.516。Endrin 和 Endrin 混合 DDT，Dieldrin 混合 DDT 乳劑各處理間之產量差異，概不顯著，似並無加用必要。

誌謝：本試驗工作進行期中承楊所長致福督促鼓勵，農復會劉博士廷蔚惠贈殺蟲劑和蒞臨指導，又承劉蒼麟、湯慶銓、余健敏、王連春、廖西湖、郭昆津諸君協助及分析，文成後，復蒙馬駿超先生詳為校閱，均此附致謝忱。

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APPLICATION'S SCHEDULES FOR THE CONTROL OF SPINY BOLLWORM (*EARIAS FABIA* STOLL) IN TAIWAN IN 1955

by

CHIA-HWA TAO and KWA-YANN SUI

SUMMARY

19.5% endrin emulsion, 50% dieldrin wettable powder and 25% DDT emulsion were tested for control of the spiny bollworm. The tests were carried out at the Chia-non farm in Taiwan. It was divided into four blocks of 12 plots each, nine difference treatments were used, including 0.025% endrin, 0.025% endrin combined with 0.0625% DDT and 0.125% dieldrin wettable powder combined with 0.0625% DDT and three checks (untreated plots) were assigned at ramdon to each blocks. Each insecticdes was applied with three different numbers of applications, namely four times, five times. or six times. The rate of applications was 7.03 liters of 19.5% endrin, 13 kgs of 50% dieldrin and 13 liters of 25% DDT at four times; 9.05% liters of 19.5% endrin, 16.75 kgs of 50% dieldrin, and 16.75 liters of 25% DDT at five times; and 9.46 liters of 19.5% endrin, 17.5% kgs of 50% dieldrin, and 17.5 liters of 25% DDT at six times per hectare. The results of these tests were summarized as follows:

1. Percentage of infestation of shedding squares and shedding bolls in the early party of the season and later in the season showed no significant difference

between the different insecticides used and the check. But in mid-season there was a significant difference between the different treatments and the check.

2. Percentage of infested bolls in early-season and mid-season except late-season was significantly higher different than between the different treatments and the check. Infestation of bolls receiving treatments averaged 23.20% to 29.97% as compared with 35.35 in the check. During late-season infestation of the spiny bollworm in all treatments was increased.
3. The number of bolls on each plant receiving treatments was higher than in the check, but there was no significant difference between the number of bolls on plants depending on the number of applications of the insecticides. The treated plant had 27.31 to 31.55 bolls per plant as compared with 15 bolls in the check, which is about double that of the control.
4. Percentage of dehiscent bolls did not show significant difference between the different treatments and the check, because the fungi (Fusarioum sp. and Diplodia gossypina Cooks) did not gain entrance through the penetrations in the boll wall made by the spiny bollworm. They did not develop because of unfavorable weather condition. It was 92.91% to 97.78% in all plots.
5. Yield of seed cotton receiving treatments was significantly higher than the check. It was 2,176 to 2,792 kgs of seed cotton per hectare as compared with 966 kgs in the check. There was no a significant difference between plots receiving five or six applications, those receiving five or six applications but there was significant as compared with those receiving four applications. In the five or six applications the index of yield (above check) was 244.31 to 289.03; and in the four applications the index of yield was 225.26 to 238.51.
6. It was found that the insecticides were about equal in effectiveness against this pest. Endrin alone or and combined with DDT, or dieldrin combined with DDT gave about the same resutls in the experiments.

Vol. 7. No. 4 December 1957

AGRICULTURAL RESEARCH

CONTENTS

Effects of Some Minor Elements on the Nursery Bed of Rice Plants (III) The Effeet of Manganese on the Yield of Paddy Rice (Water Culture Experiment) ....S. C. HSU, T. F. CHIU.... 1

Mutations in Rice Induced by X-rays (A Preliminary Report)....T. D. CHANG, S. C. HSIEH... 7

Experiment on Seed Potato Supply (1) The Primary Study of Using Ammonium Thiocyanate and Ethylene Chlorohydrin to Break Tuber Dormancy of Seed Potato....K. C. KUO...16

Control of Paddy Borer on the Second Rice Crop in 1957....C. H. TAO...28

Studies on the Relationship of Ants with Mealybug Wilt of Pineapples....S. K. SUN...31

Application's Schedules for the Control of Spiny Bollworm (Earias fabia Stoll) in Taiwan in 1955...C. H. TAO, K. Y. SUI...43

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